



Environmental Implications of Increased Reliance of the EU on Biomass from the South East US

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FINAL REPORT

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1 Executive Summary

1.1 Abstract

Against the backdrop of increased EU demand for solid biomass for energy imported from the US southeast, this study assesses the conditions, trends, effects, policy framework, and environmental risk profile relevant to the EU imports from the case study region. The US is the main exporter of wood pellets to the EU, and the growth of the industrial pellet industry has raised concerns about possible negative impacts, direct and indirect. The perceived environmental implications in forest areas of the US Southeast are assessed and four typical effects concerning changes to management of forests and land and to market wood markets in the US are identified. When these effects are matched with EU policy objectives, it appears that in particular biodiversity loss, deforestation and forest degradation, not meeting greenhouse gas performance and reduced resource efficiency can constitute EU policy risks. To identify appropriate EU action to these risks, 12 intervention tools are considered, taking into account external policy constraints and considerations of cost, effectiveness, administrative burden, policy coherence and innovation. The tools all build on existing or planned EU legislation, and include intervention tool types such as certification, LCA based footprints, quotas, no-go areas and negative lists, as well as an enforcement of the material hierarchy.

1.2 English Summary

EU biomass demand and RE targets

As of 2011, modern and traditional forms of bioenergy represented 79% of renewable energy produced globally (IPCC, 2011). Of this, 38% is considered modern forms of bioenergy for heat, electricity, and transportation fuels. The share of energy coming from biomass is projected to remain high for the foreseeable future. North America, the United States (US) and Canada, as well as the European Union (EU) are major producers and consumers of wood-based bioenergy. The demand for woody biomass for the European energy sector is rapidly growing and other sources and the volume of wood raw material used for energy is approaching the use of the wood-based products. This means that

incentives to increase global wood mobilization may trickle down the supply chains, ultimately changing forest management and harvest practices and land use.

One major driver of EU biomass demand is the climate and energy policies promoting the use of renewable energy. The 2020 Climate and Energy package sets a target of 20% final energy consumption from renewable energy by 2020. The recent proposal of the Commission for the 2030 framework for climate and energy policies further increases the share of renewable energy to at least 27% of the EU's energy consumption by 2030. It is expected that the total renewable energy consumption will be more than double by 2020 from the level 2005. According to the National Renewable Energy Action Plans, biomass used for heating, cooling and electricity would supply about 42% of the 20% renewable energy target for 2020. If this is to be achieved and the present renewables mix stays in place, the amount of biomass used for energy purposes in the EU would be equivalent to today's total wood harvest in the EU (ECN, 2015). It is therefore highly likely that EU will have to import increasing amounts of biomass and thus increase the pressure on global forest resources.

A study to improve understanding of environmental implications in the Southeast US

Objective

In response to the recent ramping up of the international trade in biomass for energy, the European Commission (COM) has called for a Study on the Environmental Implications of the Increased Reliance of the EU on Biomass for Energy Imported from North America. The study will provide a better understanding of the production of wood-based biomass for energy in the US and its environmental and policy implications, including the relevant regulatory and non-regulatory initiatives underway as regards sustainability aspects.” The study assesses implications for biodiversity, forest area, greenhouse gas (GHG) emissions and resource efficiency in the case study area as they can be linked to the increased EU demand.

Case study area: The US Southeast

The study assesses the conditions, trends and effects of the EU imports of wood biomass from a case study region, the southeastern US, referred to as the “Southeast”. The focus is largely on the states of the Atlantic and Gulf coasts, where the bulk of the industrial wood pellet manufacturing capacity is presently located. The forests of the Southeast US are diverse in both ecology and ownership. Diverse deciduous forest (hardwood trees) constitute more than 50% of the forest, the rest being naturally-regenerating mixed conifer types (softwood), pine plantations, and hardwood-softwood mixed forest types. Forests cover 40% (86 million hectares) of the land area of the region and represent 29% of the total forestland in the US (Wear & Greis, 2002; Smith, 2007; Wear & Greis, 2013). The region produces roughly 60% of the timber harvested in the US each year, and approximately 15-18% of the world's industrial Roundwood (Wear & Greis, 2013; RISI). Since the early 1940s the net area of forestland in the Southeast US has stayed roughly consistent, while its composition has changed significantly (Wear & Greis, 2002; Wear & Greis, 2013).

Forest ownership

The US Southeast has significant diversity in ownership. Forested lands in public ownership constitute 13% of the forests of the region, while the remaining 87% of

Southern forests are in the hands of non-industrial private forest owners (NIPF) (60%), and forest product companies or financial institutions (27%). Attitudes and behaviours of forest owners is a critical determinant of the nature of feedstock production systems and supply chains, and thus the environmental risks and risk mitigation measures characterizing these systems.

Regulatory and socio-economic environment

Authority to enforce federal environmental laws usually rests with Federal Agencies such as the US Environmental Protection Agency (EPA) and US Fish and Wildlife Service (USFWS), but the implementation of these laws in the context of forest management is largely delegated to state agencies. The main federal laws influencing forest management on private lands in the US Southeast include the Clean Water Act (CWA) and the Endangered Species Act (ESA). However, normal forestry operations are largely exempted from the regulatory provisions of the CWA. In addition to implementing key Federal laws, state policies can add requirements that influence forest land management activities. In addition, land use laws (e.g. zoning and property taxation) are promulgated and enforced by county and municipal governments (local governments), sometimes controlling where and how forestry is practiced. Where state forestry laws are limited, local governments in some places have created regulations curtailing forestry activities (e.g. clearcutting) through local ordinances.

Forest certification systems

Forest management certification is limited in terms of forest area, but increasingly established within the solid wood products, paper, and packaging sectors. The advancement of forest certification has been driven by the perceived need to demonstrate the responsible sourcing of timber and fibre. The three main forest certification programs of importance in the region are: the American Tree Farm System (ATFS), a program managed by the American Forest Foundation; the Forest Stewardship Council (FSC), an international certification system with a U.S. standard; and the Sustainable Forestry Initiative (SFI). Only 17% of forests in the US Southeast are presently certified, and this is mostly on industrial lands certified to the SFI forest management standard. In recent years, emerging sustainability requirements in buyer countries and public concerns have driven the creation of certification systems specifically for the bioenergy industry. Most notable is the Sustainable Biomass Partnership (SBP), an industry-led initiative formed in 2013 supported by European utilities sourcing wood pellets from North America.

Current and projected production and export to EU

Production of biomass for energy

Several different categories of biomass feedstock can be used for various energy technologies, including wood pellet production. Feedstocks for energy include wood product mill residues, logging residues, and roundwood, including pulpwood, chip-n-saw, and sawtimber. Pellet mills are generally omnivorous, being technically able to utilize either hardwoods or softwoods. What drives pellet plant fibre selection is availability of the lowest cost, lowest ash-content fibre. The quality requirements mean that logging residuals (tops and limbs) are generally poorly suited for industrial wood pellets, and its share of total feedstock volume is insignificant.

Current and projected demand

Recent growth in the US Southeast wood pellet export sector has increased such that wood pellets produced in the region are now the third largest wood product

export from the entire US, behind softwood and hardwood lumber (Goetzl 2014). Countrywide pellet manufacturing capacity has expanded from an estimated 0.55 million tonnes in 2003, to 1.24 million tonnes in 2006, 4.6 million tonnes in 2009 and approximately 7 million tonnes by 2012. Most recent estimates suggest that by May 2015 installed capacity reached 9.1 million tonnes (Spelter & Toth 2009, Aguilar et al. 2012, Biomass Magazine 2015). Over three-quarters of US wood pellet capacity is found in the Southeastern US from which over 98% of wood pellet exports are shipped (Abt et al. 2014).

Export of pellet biomass from the US Southeast to the EU

The US is the main exporter of wood pellets to the EU. Imports of US wood pellets by the EU have grown from 0.53 million tonnes in 2009 to 3.89 million tonnes in 2014. An estimated 97% of the value of all shipments of wood pellets exported from the US reached the EU in 2014 (UN Comtrade, 2015). The five largest importers of pellets from the US by tonnage are the UK, Belgium, Netherlands, Italy and Denmark. The importance of the UK market in particular has grown significantly in recent years and in 2014, it imported about 73.5% of all wood pellets exported by the US. At present, imports account for 3.84% of European bioenergy production, with supplies from North America playing the largest role (AEBIOM, 2015). Projections for wood pellet production growth vary by source. Wood product market consultants seem to agree that European demand for wood pellets out to 2025 will likely be limited to 20-22 million metric tons, of which 10-12 million tons is likely to be sourced from the US. This could equate to roughly 20% of the pulpwood currently used for paper production in the southeast, or annually harvesting a volume equal to the total growing stock on 169,000 hectares of average pine plantations in the region, or annually harvesting the small and medium sized trees across 550,000 hectares of pine plantations.

How does EU demand affect Southeast US environment?

Environmental implications of increased biomass production

The impacts of biomass production need to be evaluated against a backdrop of other factors, such as population growth and competing land uses that will continue to present significant pressure on southern forests. While actively debated, there appears to be a lack of recent empirical data regarding the role increasing demand from pellets may play in either reducing conversion pressure (incentivizing reinvestment in forests) or helping to facilitate conversion (making land clearing more cost-effective).

Harvesting of hardwoods is forecasted to increase across the Southeast. This can have impacts on the environment not only in the forests directly affected, but also on a broader landscape level, in particular in areas experiencing localized increases in harvest activities associated with increases in aggregate local wood demand. Against this backdrop, the study finds that four effects are relevant to assess for:

Effect 1: Forest type conversion from natural forests to plantations

Over the last 50 years, demand for fibre has contributed to a very significant increase in the area of plantation pine coinciding with a loss of natural forests. There are no laws that limit the conversion of natural forests to plantations. Bioenergy is expected to be the single largest source of new wood demand in the near future, and this is anticipated to drive expansion of pine plantations at the expense of both agricultural land and natural forests of comparatively high

biodiversity value. In addition, the conversion of bottomland hardwood forests (often wetland habitats) to pine can involve significant losses of belowground carbon.

**Effect 2:
Intensification of
management and
harvesting**

Intensification of management has three main dimensions: increasing the area harvested annually, increase of the amount of biomass removed (whole-tree harvests) and increases in thinnings. Research continues to assess the long-term potential impacts to forest productivity of intensive removal of nutrients and organic inputs to soils via intensive whole-tree harvests. So far, the evidence of impacts is mixed and sensitive to on-site variables. More information is needed to evaluate the effects of management activities that will be altered because of increased biomass demand such as changes in rotation length. Thus far, logging residues are not a significant feedstock for industrial wood pellets, and as such, possible impacts related to intensification of residue removals are quite small and cannot directly be attributed to pellet demand. Thinnings are another source of roundwood, in particular of lower dimension softwood. Thinning pine plantations can promote a more open environment increasing habitat value and growth rates of merchantable wood. Thinnings have decreased in the last 20 years as plantation silviculture has trended towards planting at lower densities (RISI 2015c). Raw material not met from the above sources is likely to be supplied from increased final harvest (predominantly clear-cuts). Satisfying half of the EU demand projected for 2025 from final harvests would require the total growing stock (all roundwood harvested) from around 90,000 hectares of pine plantations or that of the net-annual growth from 2.1 million hectares.

**Effect 3: Increased
pressure on forests
of high biodiversity
value**

Wood pellet mills in the southeast US are currently sourcing from areas identified by conservation organizations as having high biodiversity value. Tight pine pulpwood markets in the Coastal Plain with little room for further utilization are in some places driving new pellet plants to hardwood utilization. Some hardwood forests have high biodiversity value, especially forested wetlands and represent a very significant and increasing carbon stock. Conversion of natural forests to plantation forests is a concern and projected demands for pellet exports and domestic bioenergy suggest the practice will continue.

**Effect 4:
Displacement of
existing wood users
and possible indirect
effects.**

Traditional pulpwood users can afford to pay more for their feedstock than bioenergy. However, the industrial pellet sector is supported by European subsidies and at present, the industrial pellet sector appears perfectly capable of paying for pulpwood. Increased utilization of logging residuals (limbs and tops) could modulate forecasted price hikes but this is likely limited by current needs of the end consumer of industrial pellets. However, at present levels of demand there is little empirical evidence that significant market displacement is happening due to the current levels of demand associated with the US industrial pellet sector, although diversion of sawmill residues may be occurring in some locations. Market structure might change with sustained high demand from the pellet mills.

Much of the southern pulpwood industry is geared for pine. As pulpwood supplies get tighter and aggregate demand for feedstocks increases, it is possible that larger diameter roundwood could be used as feedstock for pulpwood consuming industries. Hardwoods are likely to be increasingly utilized by the pellet industry as pine pulpwood markets continue to tighten. On the balance, some additional

demand can still be absorbed by the region, but at some point, economic displacement and leakage would occur. Estimates vary on when and at what level of demand this happens.

Analysis of marginal effects of EU wood pellet demand observed in the Southeast US

Impacts of greater demand from the EU for wood pellets on US local forest resources are difficult to discern. Demand for wood pellets and bioenergy is a combined function of domestic and international market forces. In this study, the evaluation of the effects of greater wood pellet demand on forests of the Southeast US were explored based on ex post and ex ante analyses. The ex post analysis focused on changes in forest attributes over the 2006-2012 period, thus before the emergence of significant EU market demand. The ex-ante analysis included projections for potential changes through 2040.

Results suggest no significant changes in overall trends regarding timberland area between the Southeastern US and the Northeastern region from 2006 to 2012. Of the ex post forest structure, results suggest that within wood pellet plant procurement zones there was an indication of a decline in the number of standing-dead trees and a slight decline in above and belowground carbon in dead trees. There were no discernible effects on above and belowground carbon in live trees, nor changes in carbon in organic soil. The findings are inherently deemed exploratory due to the short time period over which the wood pellet industry has emerged in the US, imperfect data, uncertainty in future market conditions directly and indirectly affecting wood pellet manufacturing among other limitations.

Identifying possible EU policy action to address risks

Identification of appropriate EU policy action

The environmental implications related to the identified effects could compromise EU policy objectives linked to international or EU commitments. These objectives are linked to the environmental implications of the effects, and policy risks are identified as non-attainment of policy objectives because of environmental implications of increased biomass demand. Following from the international policy objectives given under UNCBD, UNFCCC, CITES, ITTO and UNSDG, and the EU policy objectives outlined in the EU Forest Strategy, the Biodiversity Strategy to 2020 and the 7th EAP, a number of EU policy objectives with relevance for solid biomass used for energy purposes were identified.

The four overarching policy objectives are:

- 1) Halt loss of biodiversity,
- 2) Halt and adapt to climate change,
- 3) Halt loss and degradation of forests, and
- 4) Promote a low carbon, resource efficient, circular, bio-based economy, which includes renewable energy sources.

EU policy action should only be taken if the effects are found to result in risk of the EU not meeting its objectives *and* if possible EU action can be identified within its mandate that effectively can address the drivers behind the risk.

EU policy action

Possible EU action is understood and thus presented as the combination of a policy setting, a format and if relevant an intervention tool. Production of forest biomass in third countries cannot be subject to EU regulation. The EU and its Member States can only regulate the users of biomass, provided these are situated in EU, and can decide what types of renewable energy sources to support. In the case of biomass, support can be subject to meeting certain requirements (e.g., regarding types, supply chains, production methods), provided they are relevant to the policy objectives to be achieved and the performance of the product (such as renewable energy).

The EU internal market rules and the obligations under WTO and GATT frame the identification of possible policy action for alleviating environmental implications of EUs increased reliance of biomass for energy form the Southeast US. In this study, EU policy action is generally understood as action taken at the EU level, including in the form of a legislative act. The intervention tools considered in this report are not policy schemes or new legislation, but possible types of operational intervention tools that could be considered further, and which could be introduced into existing or planned initiatives. Therefore, the possible intervention tools have been identified by reviewing existing (or already planned) intervention tools found in legislation already in place for their relevance, and combining these findings with possible new tools. The development of tools was also informed by third party inputs receive at and after the Brussels workshop in September 2015.

Based on the risks characteristics, and using the mitigation hierarchy, intervention tools are then developed and subsequently described for effectiveness of addressing the problem(s), expert judgment of associated cost, administrative burden, legal obstacles and not least undesirable side effects.

Intervention tools

The identified tools vary in nature, including best-available-certification, no-go area and negative list tools based on the existing Renewable Energy Directive, as well as quotas and tools based on life cycle assessment. In addition, a few innovative tools are included, such as an MAES tool based on Natural Capital Accounting and a tool extending the planned initiative on No Net Loss of Ecosystem services to energy producers. All tools have been identified via screening of existing literature and legislation, as well as planned initiatives by the EU.

| Ideal intervention tool | Effectiveness | Risks |
|-------------------------------------------------------------------------|---------------|----------------------------------------------------|
| Certification | Moderate | Risk 1: Loss of habitats Risk 2: Loss of forest |
| No go area on sourcing from specific ecosystem / forest types | Moderate | Risk 1: Loss of habitats |
| No go area on land use change | Moderate | Risk 2: Loss of forest |
| Quota on share of primary biomass wood pellets at energy producer level | Moderate | Risk 1: Loss of habitats Risk 2: Loss of forest |
| Quota on MS share of wood energy in RES target | High | Risk 1: Loss of habitats Risk 2: Loss of forest |
| MAES NCA accounting | Moderate | Risk 1: Loss of habitats Risk 2: Loss of forest |
| No Net Loss of Ecosystem Services | Low | Risk 1: Loss of habitats Risk 2: Loss of forest |

| | | |
|-----------------------------------------------------------------------|----------|----------------------------------------|
| Material Hierarchy requirement | High | Risk 3: Material Competition |
| Quota on share of waste wood in wood pellets at Energy Producer level | Moderate | Risk 3: Material Competition |
| Negative list banning specific biomass type/high value material | High | Risk 3: Material Competition |
| GHG impact formula | N/A | Risk 4: Non-attainment of GHG benefits |
| Project Based Accounting Tool | N/A | Risk 4: Non-attainment of GHG benefits |

Due to several similarities, risks 1 (loss of habitats) and 2 (increased deforestation) are addressed by the same tools, and seven possible tools could address these risks. For risk 3 (Reduced Resource Efficiency and Circularity), three tools are found. For risk 4 (Non-attainment of GHG benefits from use of biomass for energy), two tools are identified, but these were not subject to an effectiveness test, as that would have required a more detailed development of the respective methodologies, which was beyond the scope of this exercise. The tools are listed in the table below.

Most tools are found to be moderately cost efficient, mainly so because of medium effectiveness and high or medium costs. The quota tool, a positive/negative list and implementing the material hierarchy, is found to have high cost efficiency, as most of the tools do not directly address the driver, being EU demand.

In conclusion, the report does not highlight or recommend one or more tools and does not propose a policy scheme or initiative. It merely allows a better understanding of the context including the potential risk factors, and assesses a number of interventional tools in order to facilitate further discussion and exploration of possible EU action on environmental implications resulting from increased EU reliance on imported biomass for energy, in particular from the case study region.

1.3 Résumé Français (French Summary)

La demande de biomasse de le Union Européenne et les objectifs d'énergie renouvelable

En de 2011, les formes modernes et traditionnelles de bioénergie représentaient 79% de l'énergie renouvelable (ER) produite au niveau mondial (IPCC, 2011). Sur ce total, 38% est considéré comme les formes modernes de bioénergie pour les combustibles de la chaleur, de l'électricité, et du transport. Dans l'avenir prévisible, la part de l'énergie provenant de la biomasse devrait rester élevée. L'Amérique du Nord, les Etats-Unis (US), le Canada, et l'Union Européenne (UE) sont les principaux producteurs et consommateurs de bioénergie à base de bois. La demande pour la biomasse de bois pour le secteur européen de l'énergie est en pleine expansion et d'autres sources ainsi que le volume de la matière première bois utilisés pour l'énergie se rapproche de l'utilisation des produits à base de bois. Cela signifie que les incitations à accroître la mobilisation mondiale de bois peut ruisseler les chaînes d'approvisionnement, en changeant finalement la gestion des forêts, les procédés de récolte et l'utilisation des terres.

Un des principaux moteurs de la demande de biomasse de l'UE sont les politiques climatiques et énergétiques qui favorisent l'utilisation des énergies renouvelables. Le Paquet sur le climat et l'énergie à l'horizon 2020 fixe l'objectif pour 2020 de porter à 20% la part des énergies renouvelables dans la consommation d'énergie finale de l'UE. Le cadre proposé par la Commission pour le climat et l'énergie à l'horizon 2030 fixe pour 2030 l'objectif de porter la part des énergies renouvelables à au moins 27%. Il est prévu que la consommation totale d'énergie renouvelable sera plus que doublée d'ici 2020 par rapport au niveau de 2005. Selon les Plans d'action nationaux en faveur des énergies renouvelables, la biomasse utilisée pour le chauffage, le refroidissement et l'électricité contribuerait d'environ 42% de l'objectif d'énergie renouvelable de 20% pour 2020. Pour atteindre cet objectif avec le mélange actuel des énergies renouvelables, la quantité de biomasse utilisée à des fins énergétiques dans l'UE serait équivalente à la récolte totale de bois d'aujourd'hui dans l'UE (ECN, 2015). Il est donc très probable que l'UE devra importer des quantités croissantes de la biomasse et augmenter ainsi la pression sur les ressources forestières mondiales.

Une étude visant à améliorer la compréhension des implications environnementales aux États-Unis du Sud-Est

Objectif

En réponse à l'accélération récente du commerce international de la biomasse pour l'énergie, la Commission européenne (COM) a appelé à une étude sur les Répercussions Environnementales de la Dépendance Accrue de l'UE sur la Biomasse pour l'Energie Importée d'Amérique du Nord. L'étude fournira une meilleure compréhension de la production de biomasse à base de bois pour l'énergie aux États-Unis et de ses répercussions environnementales et politiques, y compris les initiatives réglementaires et non-réglementaires pertinentes en ce qui concerne les aspects de la durabilité. L'étude évalue les implications pour la biodiversité, la zone forestière, le gaz à effet de serre (GES) ainsi que pour l'efficacité des ressources dans une région d'étude de cas, car elles peuvent être liées à la demande augmentée de l'UE.

Région d'étude de cas: Les États-Unis du Sud-Est

L'étude évalue les conditions, les tendances et les effets des importations de l'UE de la biomasse de bois d'une région d'étude de cas : États-Unis du Sud-Est, nommé le "Sud-Est". L'accent est mis en grande partie sur les états des côtes de l'Atlantique et du Golfe, où est actuellement situé la majeure partie de la capacité de fabrication de granulés de bois industriel. Les forêts du Sud-Est des États-Unis sont diverses en matière d'écologie et de propriété. Les forêts décidues () diversifiés constituent plus de 50% de la forêt, le reste étant naturellement régénérantes types mixtes de conifères (de résineux), les plantations de pins, et les types de forêts mixtes bois-résineux. Les forêts couvrent 40% (86 millions d'hectares) de la superficie de la région et représentent 29% de la superficie totale des forêts aux États-Unis (Wear & Greis, 2002; Smith, 2007; Wear & Greis, 2013). La région produit 60% du bois récolté aux États-Unis chaque année, et environ 15-18% de bois rond industriel du monde (Wear & Greis, 2013; RISI). Depuis le début des années 1940, la superficie nette de terres forestières aux États-Unis du Sud-Est est resté à peu près constante, alors que sa composition a changé de manière significative (Wear & Greis, 2002; Wear & Greis, 2013).

Propriété forestière

Les États-Unis du Sud-Est représente grande diversité dans la propriété des forêts. Des terres boisées étant propriété publique constituent 13% des forêts de la région, tandis que les 87% restants des forêts du Sud sont la propriété des forestiers privés non-industriels (NIPF) (60%) et des entreprises de produits forestiers ou des institutions financières (27%). Les attitudes et les comportements des propriétaires forestiers est un facteur déterminant de la nature des systèmes de production des matières premières et des chaînes d'approvisionnement, et donc les risques environnementaux et les mesures d'atténuation des risques qui caractérisent ces systèmes.

L'environnement réglementaire et socio-économique

Le pouvoir de faire respecter les lois environnementales fédérales appartient habituellement aux agences fédérales telles que l'Agence américaine de Protection de l'Environnement ('Environmental Protection Agency' (EPA)) et US Fish and Wildlife Service (USFWS), mais l'application de ces lois dans le cadre de la gestion des forêts est largement déléguée aux organismes de l'État . Les principales lois fédérales qui influent sur la gestion des forêts sur les terres privées aux États-Unis du Sud-Est comprennent la Loi sur l'Assainissement ('Clean Water Act' (CWA)) et la Loi sur les Espèces en voie de Disparition ('Endangered Species Act' (ESA)). Cependant, les opérations forestières normales sont largement exemptées des dispositions réglementaires de la CWA. En plus de l'application des lois fédérales clés, les politiques de l'État peuvent ajouter des exigences qui influencent les activités de gestion des terres forestières. En outre, les lois sur l'utilisation des terres (par exemple de zonage et de l'impôt foncier) sont promulguées et appliquées par les gouvernements locaux, qui contrôlent parfois où et comment se pratique la foresterie. Lorsque les lois forestières de l'État sont limitées, les gouvernements locaux dans certains endroits ont créé des règlements limitant les activités forestières (par exemple de coupe à blanc) à travers les ordonnances locales.

Systèmes de certification des forêts

La certification de la gestion forestière est limitée par rapport à la superficie forestière, mais elle est de plus en plus mise en place dans les produits en bois massif, du papier et secteurs de l'emballage. La promotion de la certification forestière a été motivée par la nécessité de démontrer l'approvisionnement

responsable du bois et de la fibre. Les trois principaux programmes de certification forestière dans la région sont: le Système American Tree Farm (ATFS), un programme géré par la American Forest Foundation; le Forest Stewardship Council (FSC), un système international de certification à une norme américaine; et la Sustainable Forestry Initiative (SFI). Seulement 17% des forêts aux États-Unis du Sud-Est sont actuellement certifiées, la plupart étant des terrains industriels certifiés à la norme de gestion forestière SFI. Au cours des dernières années, les exigences de durabilité émergentes dans les pays acheteurs et les préoccupations du public ont entraîné la création de systèmes de certification qui sont spécifiques pour l'industrie de la bioénergie. L'initiative la plus remarquable est le Partenariat Durable Biomasse (SBP), dirigée par l'industrie, formée en 2013 et soutenue par les entreprises européennes qui approvisionnent les granulés de bois en Amérique du Nord.

La production actuelle et projetée ainsi que l'exportation vers l'UE

La production de biomasse pour l'énergie

Plusieurs catégories de matières premières de biomasse peuvent être utilisées pour diverses technologies de l'énergie, y compris la production de granulés de bois. Les matières premières pour l'énergie comprennent les résidus d'usine de produits de bois, des résidus d'exploitation forestière, et bois rond, y compris le bois à pâte, chip-n-saw et du bois de sciage. Les usines de granulés de bois sont généralement omnivores, car ils sont techniquement en mesure d'utiliser soit des feuillus ou résineux. Ce qui détermine la sélection de fibres de granulés est le coût et la teneur en cendres plus bas. Les exigences de qualité signifie que les résidus d'exploitation forestière (les cimes et branches des arbres) sont généralement mal adaptés pour les granulés de bois industriels, et sa part du volume de la charge totale est insignifiante.

La demande actuelle et projetée

La croissance récente dans le secteur de granulés de bois à l'exportation des États-Unis du Sud-Est a augmenté de telle sorte que les granulés de bois produits dans la région sont maintenant le troisième rang des exportations de produits de bois provenant de l'ensemble des États-Unis, derrière le bois d'œuvre de résineux et de feuillus (Goetzl 2014). La capacité de fabrication de granulés nationale a élargi, passant d'environ 0,55 millions de tonnes en 2003, à 1,24 millions de tonnes en 2006, 4,6 millions de tonnes en 2009 et environ 7 millions de tonnes en 2012. Les estimations les plus récentes indiquent qu'en mai 2015 la capacité installée a atteint 9,1 millions de tonnes (Spelter & Toth 2009, Aguilar et al. 2012, Biomass Magazine 2015). Plus des trois quarts de la capacité de granulés de bois des États-Unis se trouve dans le sud-est des États-Unis à partir de laquelle plus de 98% des exportations de granulés de bois sont expédiés (Abt et al. 2014).

L'exportation de granulés de biomasse à partir des États-Unis du Sud-Est à l'UE

Les États-Unis est le principal exportateur de granulés de bois vers l'UE. Les importations de granulés de bois aux États-Unis par l'UE ont augmenté de 0,53 millions de tonnes en 2009 à 3,89 millions de tonnes en 2014. On estime que 97% de la valeur de toutes les expéditions de granulés de bois exportés des États-Unis a atteint l'UE en 2014 (UN Comtrade, 2015). Les cinq plus gros importateurs de pellets des États-Unis par le tonnage sont le Royaume-Uni, Belgique, Pays-Bas, l'Italie et le Danemark. L'importance du marché britannique en particulier a considérablement augmenté ces dernières années et en 2014, elle a importé environ 73,5% de tous les granulés de bois exportés par les États-Unis. À l'heure

actuelle, les importations représentent 3,84% de la production européenne de la bioénergie, avec des approvisionnements en provenance d'Amérique du Nord qui jouent le plus grand rôle (AEBIOM, 2015). Les projections pour la croissance de la production de granulés de bois varient selon la source. Consultants du marché de produits en bois conviennent que la demande européenne de granulés de bois en 2025 sera probablement limitée à 20-22 millions de tonnes, dont 10-12 millions de tonnes est susceptible de provenir des États-Unis. Cela pourrait correspondre à environ 20% de la pâte à papier actuellement utilisé pour la production de papier dans le Sud-Est, ou à une récolte annuelle sur la base d'un volume total de 169.000 hectares de plantation de pins, ou à une éclaircissage annuelle de tous les petites et moyens arbres sur une surface de 550.000 hectares de plantations de pins.

Comment la demande de l'UE affecte-t-elle l'environnement des États-Unis du Sud-Est ?

Les conséquences environnementales de la production accrue de la biomasse

Les impacts de la production de la biomasse doivent être évalués dans un contexte des facteurs, tels que la croissance de la population et d'utilisations foncières concurrentes qui continueront à présenter une forte pression sur les forêts du sud. Bien qu'il soit un sujet bien débattu, il y a un manque de données empiriques récentes concernant le rôle que la demande croissante pour les granulés peut jouer soit en réduisant la pression de conversion (motivation de réinvestissement dans les forêts), soit en aidant à faciliter la conversion (rendant le défrichage plus rentable).

La récolte des feuillus est prévu d'augmenter à travers le Sud-Est. Cela peut avoir des impacts sur l'environnement, pas seulement dans les forêts directement touchées, mais aussi au niveau plus large du paysage, en particulier dans les régions qui connaissent des augmentations localisées des activités de récolte associées à une augmentation de la demande globale de bois local. Dans ce contexte, l'étude constate que quatre effets sont pertinents pour une évaluation:

Effet 1: Conversion de type de forêt, de forêts naturelles en plantations

Au cours des 50 dernières années, la demande pour la fibre a contribué à une augmentation très significative de la superficie de plantation de pins qui coïncide avec une perte des forêts naturelles. Il n'y a pas de lois qui limitent la conversion des forêts naturelles en plantations. La bioénergie devrait être la principale source de la nouvelle demande de bois dans un proche avenir, et cela devrait stimuler l'expansion des plantations de pins au détriment des terres agricoles et forêts naturelles de valeur relativement élevée de la biodiversité. Les projections suggèrent que l'expansion de la zone de plantation de pins pourrait entraîner à plus de carbone stocké dans le paysage de la biomasse aérienne sur le long terme (sur 2040), mais au détriment des forêts naturelles avec comparativement une plus grande valeur de la biodiversité. En outre, la conversion des forêts de feuillus des (souvent des habitats des zones humides) à pin peut entraîner des pertes importantes de carbone hypogée.

Effet 2: Intensification de la gestion et de récolte

Intensification de la gestion a trois dimensions principales : l'augmentation de la superficie récoltée chaque année, l'augmentation de la quantité de biomasse enlevées (des récoltes d'arbres entiers) et l'augmentation des éclaircissages. Les recherches se poursuivent pour évaluer les impacts potentiels à long terme pour la

productivité des forêts d'élimination intensive de nutriments et d'intrants organiques dans les sols par récoltes intensives d'arbres entiers. Jusqu'à présent, les preuves des impacts sont mixtes et sensibles aux variables sur chantier. Plus d'informations sont nécessaires pour évaluer les effets des activités de gestion qui seront modifiés en raison d'une demande accrue de la biomasse tels que les changements dans la durée de rotation. Jusqu'à présent, les résidus d'exploitation ne sont pas une matière de base importante pour les granulés de bois industriels, et en tant que tels, les impacts éventuels liés à l'intensification des prélèvements de résidus sont assez petites et ne peuvent pas être directement attribués à la demande de granulés. Éclaircies sont une source importante de bois rond, notamment les résineux de dimension inférieure. L'éclaircissage des plantations de pins peut promouvoir un environnement plus ouvert, en augmentant la valeur de l'habitat et les taux de croissance du bois marchand. La demande de matières premières non satisfaites des sources ci-dessus sera probablement fournie par l'augmentation de la récolte finale (principalement les coupes).

Effet 3:
Augmentation de la pression sur les forêts à haute valeur de biodiversité

Les usines de granulés de bois dans le sud-est des États-Unis approvisionnent actuellement des zones identifiées par des organismes de conservation comme ayant une valeur élevée de la biodiversité. Les marchés serrés dans la Coastal Plain ont peu de marge pour une utilisation ultérieure et à la suite de nouvelles usines de granulés de bois à certains endroits se tournent vers l'utilisation de feuillus. Certaines forêts de feuillus ont une valeur élevée de la biodiversité, particulièrement les zones humides boisées, et représentent un stock de carbone très important et croissant. La conversion des forêts naturelles en forêts de plantation est une préoccupation et la demande prévue pour les exportations de granulés et de la bioénergie nationale suggèrent que la pratique se poursuivra.

Effet 4: Déplacement des utilisateurs de bois existants et les effets indirects possibles.

Les utilisateurs traditionnels de bois à pâte peuvent se permettre de payer plus pour leur matière première que pour la bioénergie. Cependant, le secteur des granulés industriel est pris en charge par des subventions européennes et actuellement, le secteur des granulés industriels semble parfaitement capable de payer pour le bois à pâte. L'utilisation accrue des résidus d'exploitation forestière (les branches et cimes des arbres) peut moduler des hausses de prix prévu mais cela est probablement limité par les besoins actuels du consommateur final des granulés industriels. Cependant, au niveau actuel de la demande il y a peu de preuves empiriques que le déplacement sur le marché se produit en raison des niveaux actuels de la demande associée au secteur des granulés industriel américain, bien que le détournement des résidus de scierie peut se produire dans certains endroits. La structure du marché pourrait changer avec une forte demande soutenue de la part des usines de granulés.

Une grande partie de l'industrie de pulpwood dans le sud est dirigé vers le pin. Comme l'approvisionnement en bois à pâte se resserre, et la demande globale pour les matières premières augmente, il est possible que du « roundwood » de plus grand diamètre pourrait être utilisé comme matière première pour les industries consommant du bois à pâte. Feuillus seront probablement de plus en plus utilisé par l'industrie des granulés, alors que les marchés de pin de bois à pâte continuent de se resserrer. Une certaine demande supplémentaire peut encore être absorbée par la région, mais finalement le déplacement économique et la fuite

se produirait. Les estimations varient sur quand et à quel niveau de la demande cela pourrait se produire.

Analyse des effets marginaux de la demande de granulés de bois UE observés aux États-Unis du Sud-Est

Les impacts d'une plus grande demande de l'UE pour les granulés de bois provenant des ressources forestières locales des États-Unis sont difficiles à discerner. La demande de granulés de bois et de la bioénergie est une fonction combinée des forces du marché national et international. Dans cette étude, l'évaluation des effets d'une plus grande demande de granulés de bois provenant des forêts des États-Unis du Sud-Est ont été explorées sur la base des analyses ex-post et ex-ante. L'analyse ex post est centrée sur l'évolution des caractéristiques de la forêt au cours de la période 2006-2012, donc avant l'émergence de la demande importante du marché de l'UE. L'analyse ex-ante comprend des projections de changements potentiels jusqu'à 2040.

Les résultats ne suggèrent aucun changement significatif dans les tendances générales relatives à la zone d'exploitation forestière entre le sud-est des États-Unis et la région du Nord-Est de 2006 à 2012. De la structure forestière ex-post, les résultats suggèrent que, dans les zones d'approvisionnement des usines de granulés de bois il y avait une indication d'une baisse du nombre d'arbres sur pied morts et d'une légère baisse du carbone au-dessus et souterraine dans les arbres morts. Il n'y avait pas d'effets perceptibles sur le carbone au-dessus et souterraine dans les arbres vivants, ni les variations du carbone dans le sol organique. Les résultats sont par nature considérés comme exploratoires en raison de la courte période de temps sur laquelle l'industrie des granulés de bois a émergé aux États-Unis, des données imparfaites, et l'incertitude dans les conditions futures du marché qui affectent directement et indirectement la fabrication de granulés de bois.

Identification de l'action politique de l'UE

Identification de l'action politique de l'UE pour traiter les risques

Les implications environnementales liées aux effets identifiés pourraient compromettre les objectifs politiques de l'UE liés aux engagements internationaux ou européens. Ces objectifs sont liés aux conséquences environnementales des effets, et les risques politiques sont identifiés comme non-réalisation des objectifs de la politique en raison des répercussions environnementales de la demande accrue de la biomasse. À la suite des objectifs de politique internationale donnés sous CNUDB, la CCNUCC, la CITES, l'OIBT et UNSDG, et les objectifs de l'UE définies dans la stratégie forestière de l'UE, la Stratégie de la biodiversité à l'horizon 2020 et le 7^e EAP ainsi qu'un certain nombre d'objectifs de l'UE présentant de l'intérêt pour la biomasse solide utilisée à des fins énergétiques ont été identifiés.

Les quatre objectifs stratégiques généraux sont les suivants:

- 1) Arrêter la perte de la biodiversité,
- 2) Arrêt et adaptation au changement climatique,
- 3) Arrêter la perte et la dégradation des forêts, et

- 4) Promouvoir une bio-économie à faible émission de carbone, efficace dans l'utilisation des ressources et circulaire, qui comprend les sources d'énergie renouvelables.

L'action politique de l'UE ne doit être prise que si les effets pourraient entraîner le risque que l'UE ne respecte pas ses objectifs et si l'action possible dans le mandat de l'UE pourrait être identifiée qui peut répondre efficacement aux facteurs de risque.

L'action de la politique européenne

Action possible de l'UE est entendue et ainsi présentée comme la combinaison d'un cadre de la politique, un format et le cas échéant un outil d'intervention. La production de la biomasse forestière dans les pays tiers ne peut pas être soumise à la réglementation de l'UE. L'UE et ses États membres peuvent réglementer les utilisateurs de la biomasse, à condition qu'ils soient situés dans l'UE, et peuvent décider quels types de sources d'énergie renouvelables à soutenir. Dans le cas de la biomasse, le soutien peut être subordonné au respect de certaines exigences (par exemple, en ce qui concerne les types, les chaînes d'approvisionnement, les méthodes de production), à condition qu'ils soient pertinents pour les objectifs de la politique à atteindre et les performances du produit (comme les énergies renouvelables).

Les règles du marché intérieur et les obligations en vertu de l'OMC et du GATT encadrent l'identification d'une éventuelle action politique pour atténuer les implications environnementales de l'augmentation de la dépendance de l'UE en biomasse pour l'énergie provenant des États-Unis du Sud-Est. Dans cette étude, l'action politique de l'UE est généralement comprise comme des mesures prises au niveau de l'UE, y compris les actes législatifs. Les outils d'intervention examinés dans le présent rapport ne sont pas des régimes politiques ou de nouvelles lois, mais divers types d'outils opérationnels d'intervention qui pourraient être examinés ultérieurement, et qui pourraient être introduits dans les initiatives existantes ou prévues. Par conséquent, les outils d'intervention possibles ont été identifiés par l'examen des outils d'intervention existants (ou déjà prévues), et en combinant ces résultats avec de nouveaux outils possibles. Le développement d'outils a également été informé par les contributions des parties prenantes reçues pendant et après un atelier de travail.

Sur la base des caractéristiques de risque, et en utilisant la hiérarchie d'atténuation, les outils d'intervention sont ensuite développés et décrits pour leur efficacité d'aborder le(s) problème(s), un jugement d'expert des coûts associés, la charge administrative, les obstacles juridiques et en particulier des effets secondaires indésirables.

Les outils d'intervention

La nature des outils identifiés varie, y compris la meilleure certification disponible, des outils de type zone "interdite" (no-go area) et liste négative basés sur la directive existante sur les énergies renouvelables, ainsi que les quotas et les outils basés sur l'évaluation du cycle de vie (ECV). En outre, quelques outils innovants sont inclus, comme un outil MAES basé sur Natural Capital Accounting et un outil prolongeant l'initiative prévue sur les services « No Net Loss of Ecosystem » pour les producteurs d'énergie. Tous les outils ont été identifiés par l'examen de la littérature existante et de la législation, ainsi que les initiatives prévues par l'UE.

| Outil d'intervention idéal | Efficacité | Risques |
|-----------------------------------------------------------------------------------------------------------|------------|--------------------------------------------------------------------------|
| Certification | Modérée | Risque 1: Perte d'habitats Risque 2: Augmentation de la déforestation |
| Zone "interdite", par rapport à l'approvisionnement à partir d'écosystèmes / types forestiers spécifiques | Modérée | Risque 1: Perte d'habitats |
| Zone "interdite", en ce qui concerne le changement d'affectation des terres | Modérée | Risque 2: Augmentation de la déforestation |
| Quota sur la part de la biomasse primaire des granulés de bois au niveau des producteurs d'énergie | Modérée | Risque 1: Perte d'habitats Risque 2: Augmentation de la déforestation |
| Quota sur la part de l'énergie du bois dans l'objectif RES | Haute | Risque 1: Perte d'habitats Risque 2: Augmentation de la déforestation |
| MAES Comptabilité du Capital Naturel | Modérée | Risque 1: Perte d'habitats Risque 2: Augmentation de la déforestation |
| Aucune perte nette des services écosystémiques (No Net Loss of Ecosystem Services) | Faible | Risque 1: Perte d'habitats Risque 2: Augmentation de la déforestation |
| Exigence de Matériel Hiérarchie | Haute | Risque 3: Compétition Matériel |
| Quota sur la part des déchets de bois en granulés de bois au niveau des producteurs d'énergie | Modérée | Risque 3: Compétition Matériel |
| Liste négative interdisant type biomasse spécifique / matériaux de haute valeur | Haute | Risque 3: Compétition Matériel |
| Formule d'impact GES | N/A | Risque 4: Non-réalisation des avantages de GES |
| Outil de comptabilité de projet | N/A | Risque 4: Non-réalisation des avantages de GES |

En raison de plusieurs similitudes, les risques 1 (perte d'habitats) et 2 (augmentation de la déforestation) sont traités par les mêmes outils, et sept outils possibles pourraient répondre à ces risques. Pour le risque 3 (efficacité réduite des ressources et de la circularité), trois outils sont trouvés. Pour le risque 4 (non-réalisation des avantages de GES provenant de l'utilisation de la biomasse pour l'énergie), deux outils sont identifiés, mais ceux-ci ne sont pas soumis à un test d'efficacité, car cela aurait nécessité un développement plus détaillé des méthodologies respectives, ce qui était au-delà de la portée de cet exercice. Les outils sont répertoriés dans le tableau ci-dessous.

La plupart des outils sont jugés modérément rentable, principalement à cause de l'efficacité moyenne et les coûts élevés ou moyens. L'outil de quota, une liste positive / négative et la mise en œuvre de la hiérarchie matérielle, se trouve à avoir une rentabilité élevée, comme la plupart des outils ne traitent pas directement le facteur, étant la demande de l'UE.

En conclusion, le rapport ne recommande pas un ou plusieurs outils et ne propose pas un régime politique ou une initiative. Il permet simplement de mieux comprendre le contexte, y compris les facteurs de risque potentiels, et évalue un certain nombre d'outils d'intervention en vue de faciliter la discussion et l'exploration d'une éventuelle action de l'UE sur les incidences environnementales résultant de l'augmentation de la dépendance de l'UE par rapport à la biomasse importée pour l'énergie, en particulier, de la région d'étude de cas.

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2 Note for readers

As the international trade in forest biomass for energy expands, the European Commission, Directorate General for Environment has called for a *Study on the Environmental Implications of the Increased Reliance of the EU on Biomass for Energy Imported from North America*.

Scope

The Commission has asked for a study “to provide the Commission with a better understanding of the production of wood-based biomass for energy in the US and its environmental and policy implications, including the relevant regulatory and non-regulatory initiatives underway as regards sustainability aspects.”

The study region is the US southeast

The Commission further specifies that the study should thus assess the conditions, trends and effects of the EU imports of wood biomass from a case study region—the southeast US—which emerged in recent years as the single largest supplier of wood pellets to European markets beyond what is produced within the EU itself.

The geographical and policy scope of the study is illustrated in Figure 1 below. It should be noted, that the study region is the US southeast, and not as the call for tender title indicated, entire North America. Imports from Canada, or indeed other regions of the US is thus not included in the analysis. Also worth noting is that environmental implications in the EU (or outside of the US southeast in general) is not considered in this study, just as possible US legislative action to address the risks, at federal or state level, is outside scope.

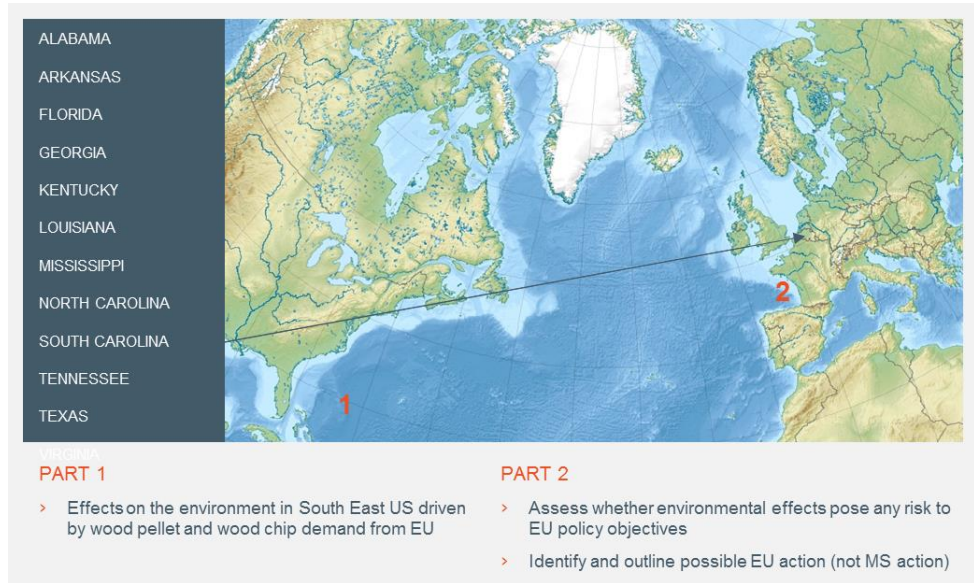


Figure 1. The two parts of the study, part 1 (chapters 3 to 7) in the US and part 2 (chapter 8) in the EU.

Building on assessments of the environmental implications in the US, the study should characterise the risks to EU policy objectives and devise EU action options to address these, if feasible. Policy objectives are to be understood to include commitments to achieve certain aspirational developments taken by the EU internationally or through major Community policies, and is not limited to specific targets. EU options for action is understood as concrete interventions that address the drivers of increased EU demand for biomass for energy from Southeast US. Such options for action is termed intervention tools in this report. As the scope of the study and its assessments is to clarify claims of environmental implications, and propose interventions to address substantiated claims that can pose a risk to EU policy objectives, this study is different from a feasibility study supporting an Impact Assessment. Therefore, the study does not claim to cover all aspects of an Impact Assessment.

Specific objective

The objective of this study is to provide the Commission with a clear view of the current use, trends, policy framework, and environmental risk profile relevant to the production of forest biomass in the US for energy use in the EU, as specifically related to the industrial pellet export sector in the southeast US.

2.1 Structure of the report

This report is organized into eight chapters. The first two chapters (3 and 4) covers contextual issues aimed at giving the reader an insight into the forests of the case study area, the related industries and wood markets (chapter 3) as well as the regulatory and socio-economic context (Chapter 4). Information provided in these chapters has been scoped to provide a basis for later chapters. The next three chapters (5, 6 and 7) cover the biomass for energy supply chain and demand situations (chapter 5), commonly perceived environmental implications of increased production of biomass (chapter 6), and detailed analysis of the marginal effect of increased EU demand on forests in the South East US (Chapter 7).

Chapter 8 analyses possible risks to EU policy objectives following from the findings of preceding chapters, and outline a number of potential EU based intervention tools that could address the risks.

US chapters (part 1)

As such, the study flow follows two paths, one US based and one EU based (see Figure 2, next page). In the US part, the environmental implications in the US southeast are investigated. Each chapter covers its own independent topics, which together provide a detailed overview of case study region and its relevance in global bioenergy trade. Topics include:

- › A contextual overview of the forests of the US South; their extent, ownership, diversity, habitat values, and role in global wood markets, (Chapter 3)
- › A detailed review of the regulatory and socio-economic environment in which forests exist in the US Southeast—key federal and state regulatory and non-regulatory programs influencing forest management and use, (Chapter 4)
- › In-depth review of energy and climate policies of greatest influence for the current and future use of wood for energy in the US, including policies related to emissions accounting from biogenic carbon sources, (Chapter 5)
- › Analysis of forest biomass feedstock supply chains, processes for pellet production, and feedstock sourcing programs in the southeast US, (Chapter 5)
- › Consolidated information on the current and forecasted demands for forest biomass for domestic energy markets in the US and for exports, (Chapter 5)
- › Analysis of potential environmental risks attributed to expanding demand for forest biomass in the southeast US, (Chapter 6) and
- › Exploration of the actual effects that the burgeoning industrial wood pellet sector is having on southern forests. (Chapter 6)
- › Ex-ante and ex-post modelling of marginal effects of EU wood pellet demand in US southeast compared to US Northeast, (chapter 7).

EU chapter (part 2)

The part of the study concerning EU, investigates three issues, each contained in one dedicated section in chapter 8:

- › Identification of EU policy objectives (section 8.2)
- › Assessment of EU Policy Risks (section 8.3)
- › Identification of EU intervention tools (section 8.4)

Study flow

The generic flow of the study, including the workshop conducted under the study contract, is depicted in the below illustration:

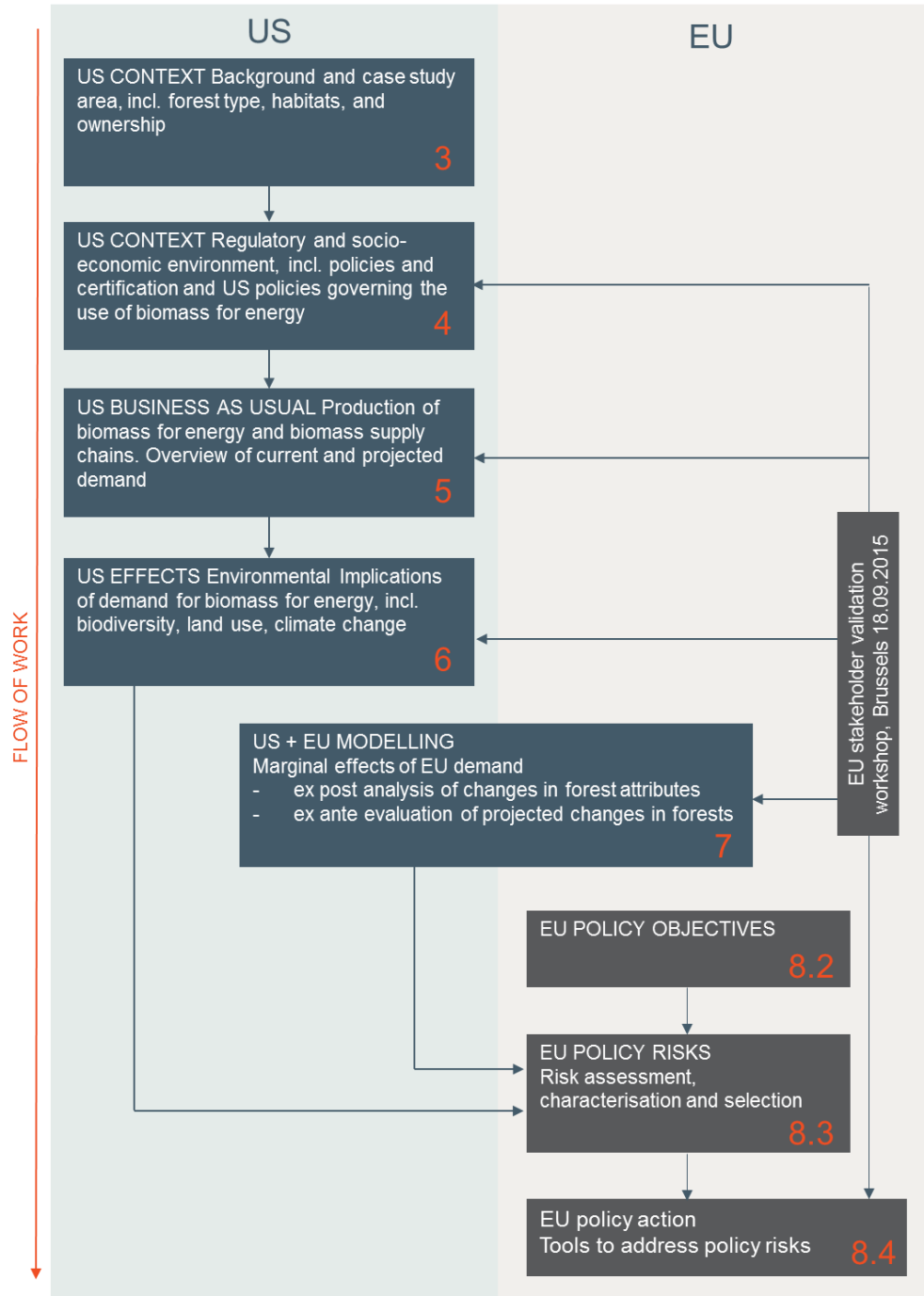


Figure 2. Generic flow of the study, including the workshop conducted under the study contract. The numbers in red refers to the chapter (or section) covering the topic.

2.2 List of abbreviations

| | |
|---------|-------------------------------------------------------------------------------------|
| BMP: | Best Management Practice |
| CITES: | The Convention on International Trade in Endangered Species of wild fauna and flora |
| CPP: | EPA's Clean Power Plan |
| DOE: | US Department of Energy |
| EC: | European Commission |
| EIA: | US Energy Information Administration |
| EPA: | US Environmental Protection Agency |
| EU: | European Union |
| FIA: | Forest Inventory and Analysis programme of the USDA National Forest Service |
| FSC: | Forest Stewardship Council |
| FWS: | US Fish and Wildlife Service |
| ITTO: | International Tropical Timber Organization |
| NIPF: | Non-industrial private forest owner |
| PEFC: | Programme for the Endorsement of Forest Certification |
| REDD+: | Reducing Emissions from Deforestation and Forest Degradation |
| USDA: | US Department of Agriculture |
| UNCBD: | United Nations Convention on Biological Diversity |
| UNFCCC: | United Nations Framework Convention on Climate Change |
| UNFF: | United Nations Forum on Forests |
| UNSDG: | United Nations Sustainable Development Goals |

2.3 Glossary

Chip-n-saw. Roundwood sized material (23 – 28 Cm in diameter), typically available at \$10 - \$20/green ton for stumpage.

Clean Power Plan: Clean Power Plan (CPP) is set to limit CO₂ emissions from existing power plants, which account for almost 40% of US CO₂ emissions. Discussed further below, the CPP intends to reduce emissions by 32% from the power sector by 2030, compared to 2005 levels.

Counterfactual scenario: Approach used in evaluation of public policy impacts. It identifies and defines "what would have occurred if some observed characteristics or aspects of the processes under consideration were different from those prevailing at the time."

Endemism: The ecological state of a species being unique to a defined geographic location and not found elsewhere in the world.

Forest Inventory and Analysis (FIA) Program: The FIA program is a collection of related surveys designed to focus on different aspects of America's forested ecosystems. The forest monitoring component is the best-known component of the FIA program. This component consists of a systematic sample of sites across all forested lands of the US.

Growth-to-drain ratios: In a forested area, the amount of new tree growth per unit time (typically a year) versus the amount of tree removals through harvesting.

High-grading: Removing only the highest value trees and leaving a degraded lower quality forest.

Leakage: The forceful change in the supply and demand equilibrium within forest product markets in an area, causing other market actors to shift their activities, such as timber harvesting and procurement elsewhere.

Logging residues: These are the tops, limbs, and other non-merchantable materials made available for collection during Roundwood timber harvests.

Northeastern US: Region defined by the quadrant delimited by the states of Maine, Maryland, Minnesota and Missouri. The region served as a counterfactual scenario to trends in the Southeastern US.

Proxy counterfactual scenario: In the context of the *ex post* study in this report it refers to a region identified as one that the Policy in question did not target and had no effects. Differences in quantifiable attributes assess likely impacts associated to a policy. The use of a counterfactual proxy scenario, although an important tool to help answer policy impact questions, can never unequivocally determine causation.

Pulpwood: Sections of stems from 23 Cm in diameter down to 5 – 10 Cm in diameter (debarked) and other material of this size. This may also include un-merchantable fibre (rough and rotten).

Renewable Portfolio Standard = mandate electric power producers to establish a minimum percentage of their capacity as renewable

Roundwood: Logs delimbed and removed from forests through harvesting.

Sawtimber: Typically not used for energy. Logs +28 Cm in diameter, typically available at \$25-40/green ton for stumpage.

Slash: Coarse and fine woody debris generated during logging operations in the form of limbs and tree tops.

Southeastern US: Region defined by the quadrant delimited by the states of Arkansas, Virginia, Louisiana and Florida

Standardized regression: Statistical regression where standardized (or beta) coefficients are estimated such that they represent the number or standard deviations the dependent variable will change per standard deviation increase in the explanatory variable. Standardized regression coefficients remove the unit of measurement of explanatory and dependent variables to ease comparison of relative effects of variables measured on different units.

Wood product mill residues: The by-products of wood product operations such as sawdust, wood shavings, and chips. This is the cleanest form of feedstock and is preferable for pellets and other products.

3 Context of the US southeast

This study assesses the conditions, trends and effects of the EU imports of wood biomass from a case study region, the southeastern US,¹ also referred to as the “Southeast” (see Figure 3). The focus is largely on the states of the Atlantic and Gulf coasts and even more specifically the Coastal Plain physiographic region, where the bulk of the industrial wood pellet manufacturing capacity is presently located.

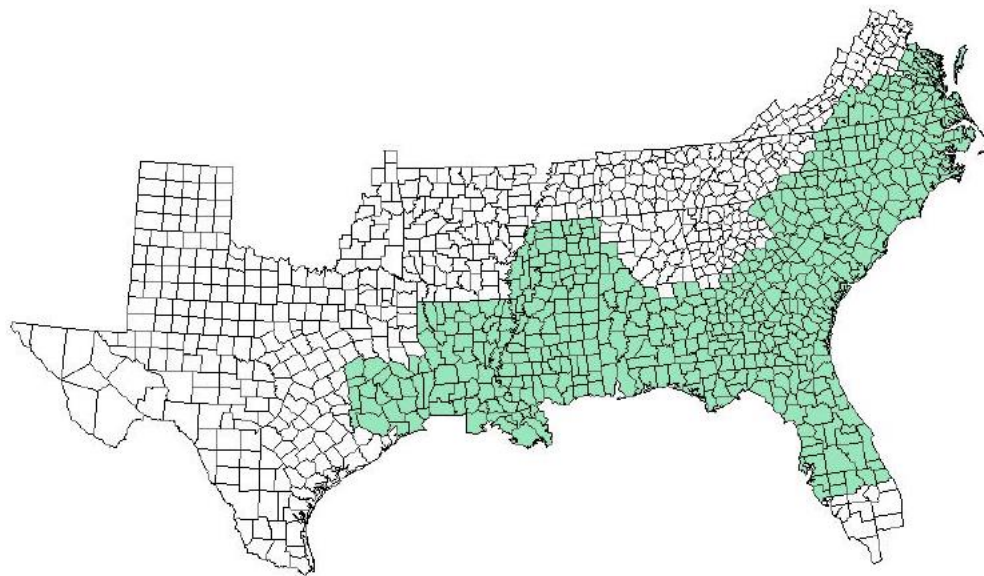


Figure 3. Wood procurement region for announced and operating pellet and bioenergy facilities in the US South. Source: Abt et al., 2014.

The forests of the Southeast US are diverse in both ecology and ownership. Diverse deciduous forests of oaks, hickories, beech, tulip poplar, and many other species constitute more than 50% of the forest, the rest being naturally regenerating mixed conifer types (softwood), pine plantations, and hardwood-softwood mixed forest types. Naturally regenerating hardwood forest types are

¹ For purposes of this report, the Southeast US region is comprised of the very eastern region of Texas, Arkansas, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Tennessee, Kentucky, and Virginia.

dominant in the Piedmont region, transitional to upland running Southeast to north across the entire region. Natural and planted pine predominate the Coastal Plain (sandy lowlands stretching from Texas to the Mid-Atlantic region of the US).

The Southeast produces roughly 60% of the timber harvested in the US each year, and approximately 15 - 18% of the world's industrial Roundwood (Wear & Greis, 2013; RISI, 2015a; RISI, 2015b).² On the balance, tree growth region-wide has exceeded timber removals in recent years (See Appendix B). This was not always the case, and in fact, as was the case in Europe, industrialization and the expansion of agricultural lands in North America was accompanied by widespread deforestation across the eastern US – with forest clearing for agriculture largely subsiding by the 1920s (Smith et al., 2003). Forests have recovered due to the relocation of agriculture to other regions and an increased use of fossil fuels, which replaced wood as the primary fuel in pre-industrial America (Ryan et al., 2010). However, while the extent of forests in the eastern US have returned, it is estimated that only a third of forest carbon stocks lost through deforestation have recovered (Ryan et al., 2010).

In the Southeast, reforestation was spurred on by government-driven planting campaigns and burgeoning timber demand. Since the early 1940s, the net area of forestland in the Southeast US has stayed roughly consistent, while its composition has changed significantly (Wear & Greis, 2002; Wear & Greis, 2013).

3.1 Southern Forests overview

The forests of the Southeast have some of the highest biodiversity and growth rates of any temperate region on Earth. Forests cover 40% (86 million hectares) of the land area of the region and represent 29% of the total forestland in the US (Wear & Greis, 2002; Smith, 2007; Wear & Greis, 2013).

The Southeast US contains the greatest tree diversity of any region in North America outside of Mexico. Over 55% of the trees in the region are deciduous (hardwoods), from oak/hickory upland mixed hardwood forests in the Piedmont³ to cypress/tupelo bottomlands. Natural and planted conifers (softwoods) predominate on the Coastal Plain (see Figure 4 and Figure 5) (Abt, 2014; Wear & Greis, 2002).

² This level of production required 250-275 million green tonnes of wood annually between 1995 and 2007. During the recent recession southern regional wood product output dropped well below 250 million green tonnes but has returned to prior levels.

³ The piedmont physiographic province is a plateau region that extends through central Virginia, North Carolina, South Carolina, and Georgia and into eastern Alabama from about 50 masl to 300 masl.

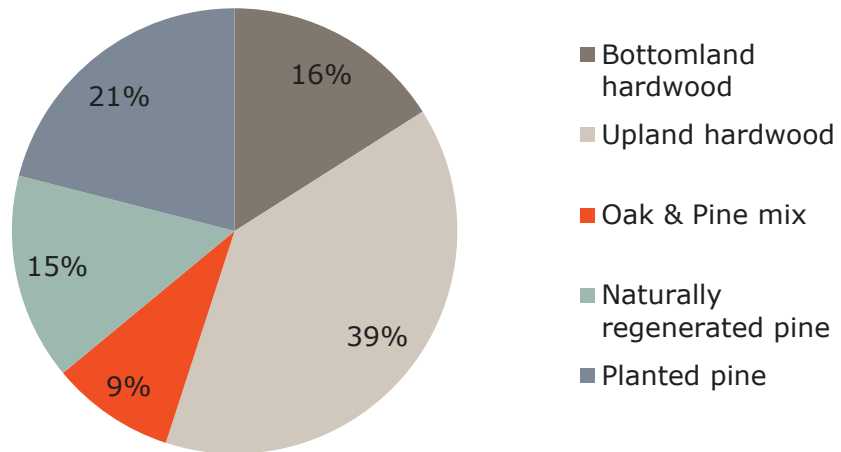


Figure 4. Forest types across the Southeast US as percentage of whole (2010 FIA data). Source: Abt, 2014.

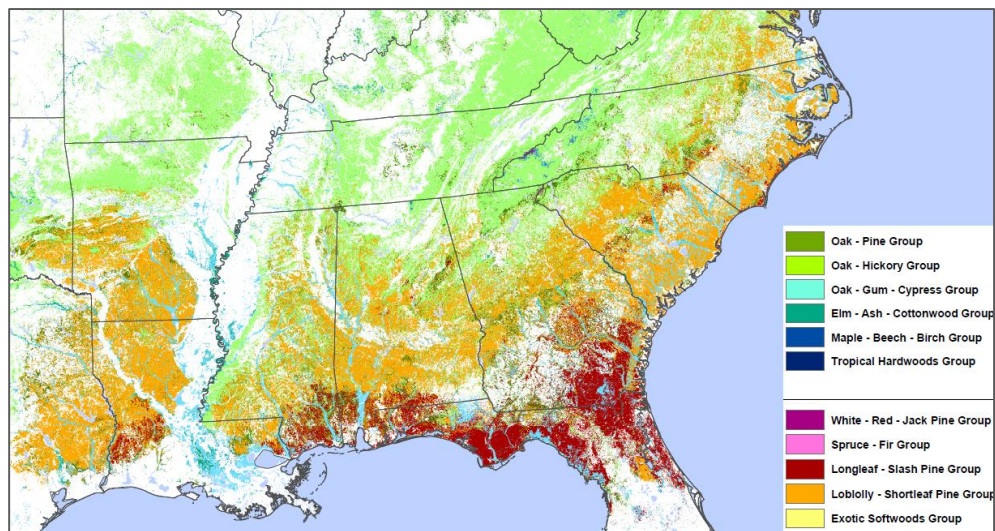


Figure 5. Common forest types mapped in the US south. Source : http://data.fs.usda.gov/geodata/rastergateway/forest_type/index.php.

3.2 Habitats of Concern

Southern forests support some of the most diverse ecological assemblages in North America, containing 3,000 plant species, nearly 2,600 bird species, and 246 species of mammals, 170 amphibian species, and 197 reptile species (Trani, 2002). In 2016, the Critical Ecosystem Partnership Fund designated the coastal plain of the southeastern US as its 36th global biodiversity hotspot in need of conservation. The Southeast has a relatively high rate (11%) of plant and animal species considered at-risk (i.e. vulnerable, imperilled, critically imperilled, or

thought to be extinct) (Wear & Greis, 2002; Natureserve, 2015). The region is particularly known for a high degree of endemism possessing plants and animals occurring nowhere else (see Figure 6).

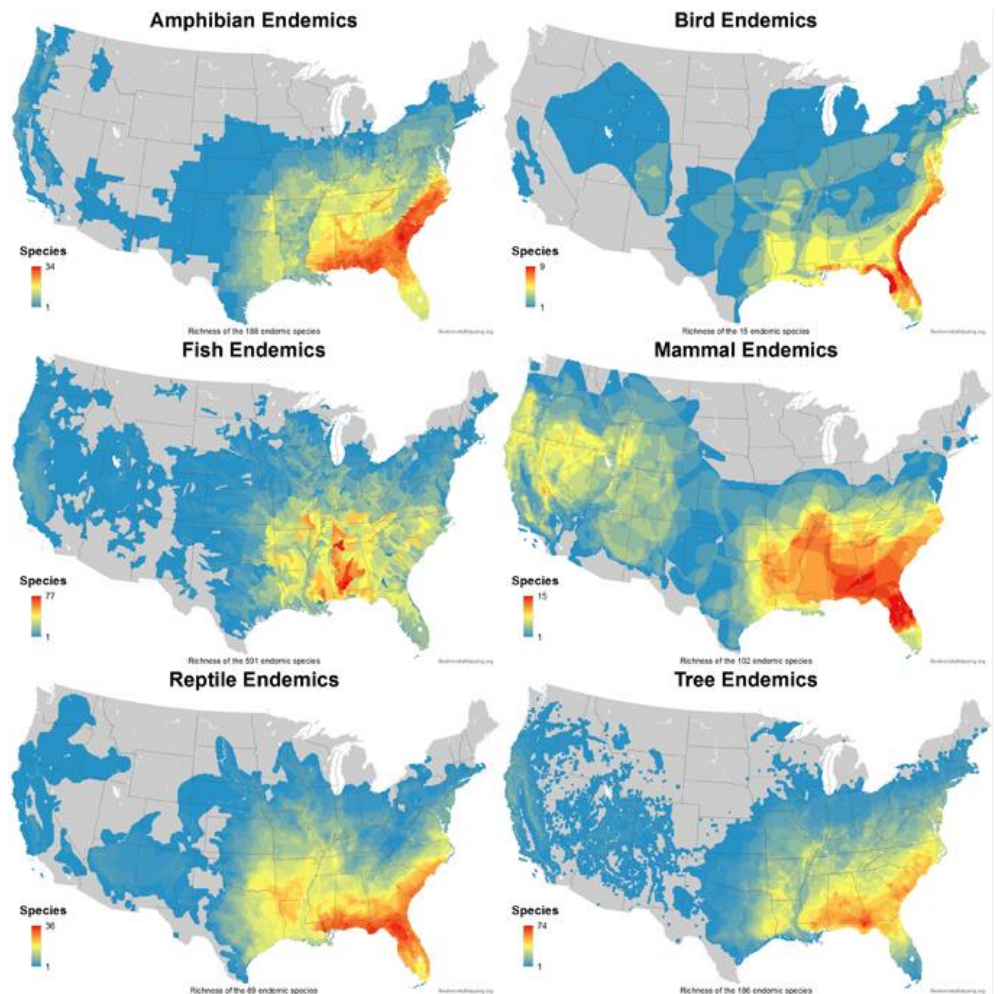


Figure 6. Biodiversity in the conterminous United States as measured by species endemism. Source: Jenkins et al. 2015.

As identified by various government agencies, such as the US Department of Agriculture (USDA) Forest Service, two forest types on the Coastal Plain, bottomland and floodplain forests (also known as forested wetlands) and both longleaf and shortleaf pine savannah systems, are among the forests of greatest conservation concern. Numerous endangered and endemic species depend on these two ecosystems. In addition to these distinct ecosystems two sub-regions of the Southeast were recently identified as having both globally significant biodiversity and low levels of protection; the Florida panhandle and the watersheds of the Southern Appalachian Mountains in Tennessee, Alabama, and Georgia, which possess several rare reptiles, amphibians, fish, and plant species (Jenkins et al., 2015).

The growth of the industrial pellet industry has raised concerns about possible negative impacts to biodiversity, either: directly through the harvest of forest types that harbour significant biodiversity; or indirectly, by intensifying forest harvests, increasing competition for regional forest stocks, and/or by adding economic

incentives to convert lands to other uses. Harvest intensity and changes in forest carbon stocks have implications for the net-GHG effects of bioenergy use as well.

A key purpose of this study is to address the potential effects European demand for wood pellets could have on habitats of concern. To begin to address this question we start with a description of some of the most relevant habitats of concern.

3.3 Forest Type Descriptions

3.3.1 Longleaf pine

Longleaf pine (*Pinus palustris*) forests once dominated the Coastal Plain and piedmont regions covering 37 million hectares from Texas to Virginia (Frost, 1993; Dobbs Foundation, 2011; Van Lear et al., 2005). Nearly 98% of the historic coverage of longleaf pine has been lost. A habitat of global significance, nearly 25% of all terrestrial species existing in the US and Canada are found in longleaf ecosystems (Stein et al., 2005). As much as 27 plant species and 29 animal species endemic to the longleaf system are listed as federally threatened or endangered. Expansion of urban areas and conversion to agriculture and pine plantations have been identified as the major drivers of loss given the comparative economic value of these alternative land-uses (Frost, 1993; Van Lear et al., 2005). Recent losses have been significant, with as much as 35% (over 300,000 hectares) of the area present in the early 1990s being lost by the mid-2000s (Frost, 1993).

In part due to the investment of millions of dollars by Federal and state governments, efforts to restore longleaf pine habitats are moving forward, but continued loss of the remaining fragments of this once extensive ecosystem is forecasted. A major challenge to longleaf conservation is that many of the remaining fragments are scattered across thousands of parcels under varying levels of protection.⁴ For instance, in Georgia 87% of longleaf is privately owned, mostly by small non-industrial forest (NIPF) owners (Dobbs Foundation, 2011). It is largely the decisions of thousands of families and individuals that dictate the success of efforts to conserve this habitat type. While less imperilled, shortleaf pine (*Pinus echinata*) is another naturally regenerated pine species common to savannah habitats in the Southeast, facing similar threats.

3.3.2 Forested Wetlands

The US South contains over 12 million hectares of forested wetlands. Comprising various distinct forest types, as many as 70 tree species—40 of which hold commercial value, occur within these wetlands (Hicks et al., 2004). Found across the low-lying moist areas of the Atlantic and Gulf coasts and extending inland along the extensive network of rivers and streams of the Coastal Plain, these highly

⁴ <http://www.americaslongleaf.org/resources/maps/>

productive systems are adapted to thrive in places with episodic flooding, and in some instances continuous inundation.

Loss and degradation of this habitat is a longstanding concern. By 1984, as much as 30% of the original extent of wetlands in the US south had been drained and converted to other uses, particularly agriculture and pine plantations (Hefner & Brown, 1984). For example, it is estimated that in North Carolina about 25% of the original extent of coastal forested wetlands were drained (partially or otherwise) and converted to pine plantations between 1950 and 1990 (Spring, 1991). In Georgia, the area of cypress swamp has declined by as much as 16% from 1991 to 2005 (Conner et al., 2012).

Forested wetlands are prevalent on family forestland across the Southeast. Decisions to harvest forested wetlands are less predictable and studied than plantation pine (Abt, 2014; Abt et al., 2014). The economics of timber harvests in natural wetland forests are quite different than with planted pine (SGSF, 2009a).⁵

While federal laws do exist to regulate the destruction of wetlands, significant pressures persist and are well documented. The USDA Forest Service has identified that in addition to outright loss to other uses, the intensity of timber harvesting of forested wetlands in the Southeast has degraded the quality of remaining coastal wetland forests (Wear & Greis, 2002).⁶ Others argue that at present, pellet demand is less of a risk to forested wetlands in parts of the Southeast, such as the Mississippi Alluvial Valley, than deforestation for urbanization, sea level rise, high-grade harvesting for other purposes, and invasive insects (Gardiner, 2014), with harvesting adding to those pressures.

Opposition from environmental NGOs is largely focused on forested wetlands in parts of the Atlantic Coastal Plain where a concentration of new pellet demand is now present. Harvesting of older wetland forests (those in the +80 year age class, representing only 12% of the forested wetland acres in the region) harbouring high biodiversity value and carbon stores, is viewed with particular ire (NRDC, 2015a; Dogwood Alliance, 2013). According to FIA data, a significant amount of bottomland hardwood forests in the Atlantic Coastal Plain is concentrated in the +50 year old age class, much of it between 50 and 80 years old.

⁵ The Southern Group of State Foresters suggests that: "Management activities between the establishment of the forest and the eventual harvest may be minimal, and timber harvesting occurs less frequently and unpredictably, often driven more by markets, hydrologic conditions and landowner objectives than by a planned harvest age or "rotation," as in the case of typical pine management."

⁶ Wear & Greis (2002) recognize that, "Forest loss combined with intensified forest management could have cumulative negative effects on coastal wetlands, both through direct wetland loss and through modification of hydrological regimes. The flatwoods, one of two areas in the South with the highest concentration of endangered animal and plant species, contain many imperilled amphibians, crustaceans, and reptiles. These problems are of especially great concern in the Florida Panhandle."

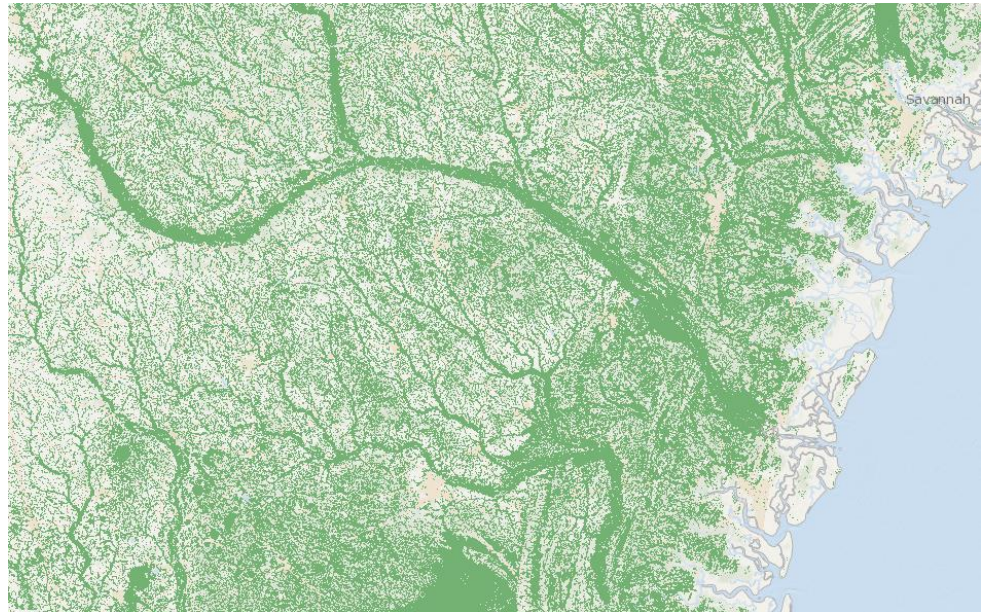


Figure 7. Forested Wetlands in the Coastal Plain in southeast Georgia. Note the city of Savannah in the upper right corner. Source: South Atlantic Landscape Conservation Cooperative, National Land Cover Database (2011).



Figure 8. Extent of Forested Wetlands in the Coastal Plain of southern Virginia and Northern North Carolina. Source: South Atlantic Landscape Conservation Cooperative, National Land Cover Database (2011).

Recently, the National Wetlands Inventory conducted by the US Fish and Wildlife Service indicates that from 2004 to 2009, forested wetlands across the US declined by an estimated 256,206 hectares, with 41% of this loss occurring in North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Arkansas (Dahl, 2011). It is estimated that 26% of the loss is permanent

conversion to urban/suburban development, while 74% resulted from a re-classification of forested wetlands to other wetland types (e.g. shrub wetlands), which can occur as a result of timber harvesting.

Most of this wetland type change occurred following extensive harvesting in pine plantations that are located on sites of previously converted bottomland hardwood forests. As allowed under the federal Clean Water Act, seasonally wet pine plantations can be temporarily drained following harvest to help facilitate regeneration. If the hydrologic cycle is restored following regeneration then it is generally believed that potentially adverse impacts of harvesting (soil carbon loss, water quality degradation, etc.) are minimal. While not differentiating between bottomland hardwoods and low lying plantations, the National Wetlands Inventory identified the footprint of forested wetlands harvesting to account for “56% of all wetland losses”⁷ between 2004 and 2009 (Dahl, 2011).

Most of the objections to forestry operations in wetlands of the Southeast raised in recent years focus on clearcutting (NRDC, 2015a). Indeed, the prevalent policy and legal framework allows clearcutting of forested wetlands as long as this practice is part of an ongoing forest operation with trees being regenerated following harvest. Clearcutting is a commonly practiced silvicultural system in multiple forest types in the South and this extends to bottomland forests. A review of southern hardwood silviculture by the USDA Forest Service (Hicks et al., 2004) states:

- › *In spite of its lack of aesthetic appeal, clearcutting is often the best way to regenerate hardwoods, especially degraded or impoverished stands....Opposition to clearcutting often results from the visual impact of the treatment and from wildlife considerations. We recommend that the size of clear-cuts not exceed 20 acres. This maintains the silvicultural benefits of clearcutting while minimizing the adverse aesthetic effects. Additionally, it is desirable that (1) the harvested area should be configured to the landscape with scalloped edge; (2) declining, overmature, or hollow trees should be left standing for wildlife purposes (approximately 2 per acre); and (3) dead and downed trees should be left on site for associated flora and fauna.*

Such management prescriptions, as suggested above (e.g. limits on opening size, retention of stand features, design of cutblock edges, etc.) are not standard practice in the region, or formally integrated into existing voluntary management practice guidelines outside of perhaps forest management certification standards.

Clear cutting is a legitimate silvicultural system in the forest management toolbox, but like any tool, there are appropriate and inappropriate uses. Identifying the appropriateness of one approach or another is subjective to one’s own value orientation, background, and training, hence the continued debate on this subject.

⁷ Note that the National Wetlands Inventory often reclassifies recently harvested wetlands into another wetland type so it may be more appropriate in some instances to consider this as habitat degradation rather than outright permanent loss.

3.3.3 Upland Hardwoods

About 39% of Southeast US forests are upland hardwoods, which are prevalent across much of the Piedmont region. This region faces the greatest threats of forest loss related to urban development of any sub-region in the South, being forecasted to lose 21% of its forest area by 2060 (Wear & Greis, 2013). In addition to outright loss, forest parcelization (increasing numbers of owners) and fragmentation of forests, are related concerns across a much greater area of upland hardwood forests. Many forests of this type have been extensively high-graded, resulting in simplified forest structure, degraded habitat values, reduced carbon stocking, inferior genetics, and forests of substantially lower economic value for timber.⁸

To date, as most of the pellet mills geared for export are locating in the Coastal Plain the upland hardwood forests of the piedmont and mountains are less likely to be directly impacted by wood pellet export facilities under the current configuration of the industry. However, should domestic markets for wood bioenergy and pellet exports expand, upland hardwoods could be increasingly sought due to the vastness of these forests and the large volumes of low-grade timber they contain (Abt, 2014).

3.3.4 Pine Plantations

During much of the 1900s, pine plantations were established in part to recuperate lands degraded by agriculture. Today, about 21% of Southeast forestland (+16 million hectares) is intensively managed and highly productive plantations of native pines, most of which are located in the Coastal Plain (Wear & Greis, 2013). While representing less than 3% of the softwood cover globally, southern pine plantations produce more than 18% of the global industrial softwood supply, 22% of the softwood pulp production, and about 90% of the world's fluff pulp production (RISI, 2015a; RISI, 2015b), making the region among the most significant players in the global fibre supply.

Strong markets for southern yellow pine (loblolly and slash pine) grown in plantations are a major driver of the forest economy and land use within the Southeast. These plantations produce saw logs, chip-n-saw, and pulpwood. Thinnings produce low-quality logs as pulpwood. Larger high-quality trees are used for chip-n-saw and saw logs harvested at later points in the rotation. Treetops from these logs also provide pulpwood. Across the southeast thinnings have decreased as planting densities have decreased in the last 20 years (RISI 2015c).

From an environmental integrity perspective, plantations pose advantages and disadvantages (Price et al., 2006). Some contend that under certain conditions plantations provide net environmental benefits by taking pressure off of natural

⁸ <http://www.wlf.louisiana.gov/wildlife/forestry-program>
<http://www.dof.virginia.gov/manage/hardwood/how-to.htm>

forests by producing significantly greater quantities⁹ of wood than natural forests (Bowyer, 2001). Retaining less intensively managed forests in the landscape, intermixed with intensively managed pine plantations, provides essential habitat features typically less available in intensively managed pine stands, in sufficient quantities for species to persist (Hein et al., 2009; Miller et al., 2009; Bender et al., 2015).

Others express that increased productivity is not worth a direct trade-off with a natural forest or displacement of other forest types within the landscape. Land scarcity and the comparatively lower economic value of natural forests can stimulate conversion of natural forests to plantations (Friedman, 2006). Extensive conversion of natural pine forest types to planted pine has occurred since the 1950s, significantly reducing the extent of natural pine across the Coastal Plain (Wear & Greis, 2013; Abt, 2014).

3.4 Forest Ownership in the US Southeast

In addition to its diversity of forest types, the south has significant diversity in ownership. Forested lands in public ownership constitute 13% of the forests of the region. They include land owned by municipalities, counties, states, and the federal government; and are usually “permanently” allocated to current uses (i.e. forest), are often managed for forest products, and are managed through decision processes that include some form of public engagement.

The remaining 87% (about 75 million hectares) of Southern forests are in the hands of *non-industrial private forest* owners (NIPF) (60%, about 52 million hectares), and forest product companies or financial institutions (27%, about 23 million hectares). Whereas corporate ownerships are acquired and managed for financial returns from timber or real estate development, NIPF or “family forests” are typically smaller holdings with a wide range of ownership objectives and varying levels of interest and experience in forest management (Majumdar et al. 2008; Butler et al. 2007; Butler, 2008; Butler & Wear, 2013). Within this group, there are several variations, e.g. family trusts, limited liability corporations (LLCs), family limited partnerships (FLPs), estates, etc.

Corporate landowners usually follow a detailed and third-party certified forest management plan designed to maximize timber yield through intensive management, which is the primary ownership objective. Restructuring of corporate ownerships in the 1990s and 2000s has led to management regimes that are more often aimed at sawtimber production and longer rotations to maximize returns from timber, as compared to how these lands were managed when they were owned directly by pulp-wood using enterprises. Given these factors, this landowner group

⁹ Through intensive management, southern pine plantations produce about 6 dry tons per hectare per year of biomass over a 25 year rotation. Whereas a naturally-regenerated Loblolly-shortleaf forests in the same region produce less than a third of this volume due to the natural open environment of these forest types, and typically are managed on much longer rotations than plantation systems (Smith et al., 2006).

is considered the most price responsive in their willingness to supply wood to markets.

In the Southeast, the average size for NIPF landholdings is 11.7 hectares, although 60% of family forest parcels are at least 40.5 hectares (Wear & Greis, 2013). Less than 5% of NIPF owned lands in the Southeast are covered by a written forest management plan (Wear & Greis, 2013). Consequently most harvesting in the region occurs without multi-year planning and advice from a qualified natural resources professional. If a knowledgeable professional is not consulted to identify sensitive biodiversity resources, and/or a management plan written to inventory such areas, biodiversity could very well face greater risk exposure (Pan et al., 2007; Butler, 2008; Silver et al., 2015).

Given their dominance across the landscape, decisions of NIPF owners can “collectively enhance or degrade the landscape,” (Butler et al., 2007). Wood pellet plants are virtually guaranteed to source a considerable portion of their supply from these lands. Two thirds of family forest owners have harvested and sold trees from their land, so about eight of every ten acres of privately owned forestland in the Southeastern US is owned by landowners who include timber harvesting in their forest management objectives (Butler & Wear, 2013).

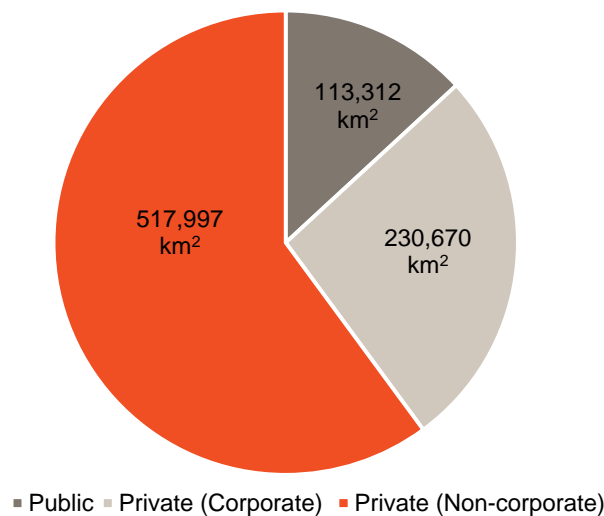


Figure 9. Forest ownership in the Southeast US. Source: Wear & Greis, 2013.

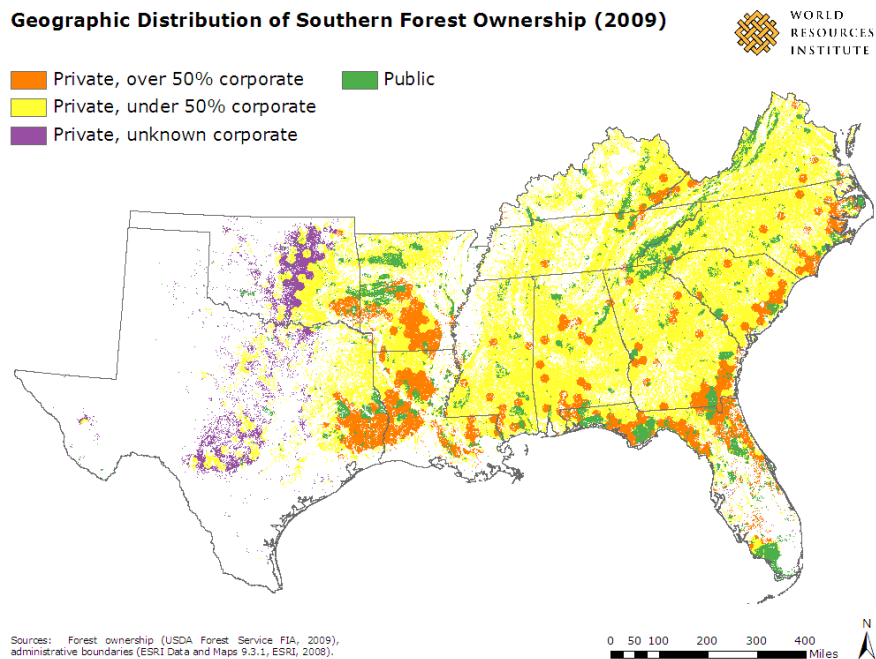


Figure 10. Geographic Distribution of Forest ownership in the Southeast US. Source: Hanson et al., 2010.

3.4.1 NIPF owner behaviour

Attitudes and behaviours of forest owners is a critical determinant of the nature of feedstock production systems and supply chains, and thus the environmental risks and risk mitigation measures characterizing these systems. Likewise, the *social availability of wood supply* is a function of landowner willingness to harvest, financial constraints such as parcel size,¹⁰ accessibility (distance to markets), and development pressures (Butler et al., 2010).

While financial return is the main objective of corporate landowners, this is not always the case for family forest owners. A majority of these forest owners relay that income generated through harvesting is a secondary¹¹ objective (Butler, 2008). Yet, even when timber and biomass production are low on their list of priorities NIPF owners still contribute significant volumes of timber to the forest economy. In fact, Kilgore et al. (2015) recently determined that as much as 63% of NIPF owners surveyed across the US have harvested timber while only 23% indicate timber management as a primary ownership objective. When harvests occur, they are

¹⁰ Butler et al. (2010) and Paula (2009) identify 8 hectares as being the smallest scale on which harvests are economically viable. In the South, the average family forest parcel is 11.7 hectares although 60% of all NIPF land is in parcels of 40.5 hectares or more (Wear & Greis, 2013).

¹¹ In the 2006 USDA Forest Service National Woodland Owners Survey, the most often cited primary reason NIPF owners own their land are: beauty/scenery; it's part of home, nature protection; privacy, family legacy; privacy. This survey contains statistically valid information from approximately 16,000 US family forest owners regarding their attitudes, ownership purposes, and current and future land management objectives. <http://www.fia.fs.fed.us/nwos/>

often not part of a long-range silvicultural plan, but rather a response to a personal financial need.

Yet, compared to the rest of the US, family forest owners in the South are more likely to have income from timber harvesting as a main ownership objective (see Figure 11). This is particularly the case for landowners on the Coastal Plain, the region with the bulk of wood pellet activity (Kaetzel, 2011).

Conrad et al. (2011) found a high willingness to harvest biomass among US South forest owners “if the price is right.” This was also the case in Alabama (Paula, 2009) and in Arkansas, Florida, and Virginia (Joshi & Mehmood, 2011). Aguilar et al. (2014a) however, points out that the influential effect of biomass price on landowner willingness to harvest is a fraction of revenues from the sale of higher-valued sawtimber.

In North Carolina, Morris (2014) found that 43% of NIPF owners were either interested in supplying biomass to energy markets, were actively considering supplying biomass, or were already supplying biomass while 57% were not interested in supplying biomass. In Alabama, Paula (2009) found that 61% of landowners were willing to supply timber for energy production and that 73% were willing to supply logging residues for energy markets. Conrad et al. (2011) suggest 55% of private forest owners in the US South would be willing to harvest timber more often as a result of energy demands demanding more fibres as a means of increasing revenues from already planned harvests.

Pan et al. (2007) found intensive biomass harvests that cleared the site to be more appealing to landowners, perhaps because it reduced expenses for associated with prepping the site to be replanted or to be cleared for other uses. Landowner willingness to supply wood for energy is higher for those having pine plantations (Joshi et al., 2013). In addition, the literature to-date suggests that woody biomass prices will likely have greater effects among family forests of 20 - 100 acres (8.1 - 40.5 hectares). In particular, among larger ownerships (>100 acres; >40.5 hectares) timber products tend to dominate owner’s management decisions - while the effects of potential biomass revenues are marginal (Aguilar et al., 2014b).

Timber prices and the cost of harvesting influence landowner decisions about when and how to harvest. It may be that the local availability of a market outlet for the lower value portions of harvests can influence landowner decisions. However, at least one study examining this question in North Carolina found “*no notable significant differences in landowner perceptions of the biomass industry and willingness to supply based on the region of the state they are located in or their proximity to bio-energy facilities*” (Morris, 2014).

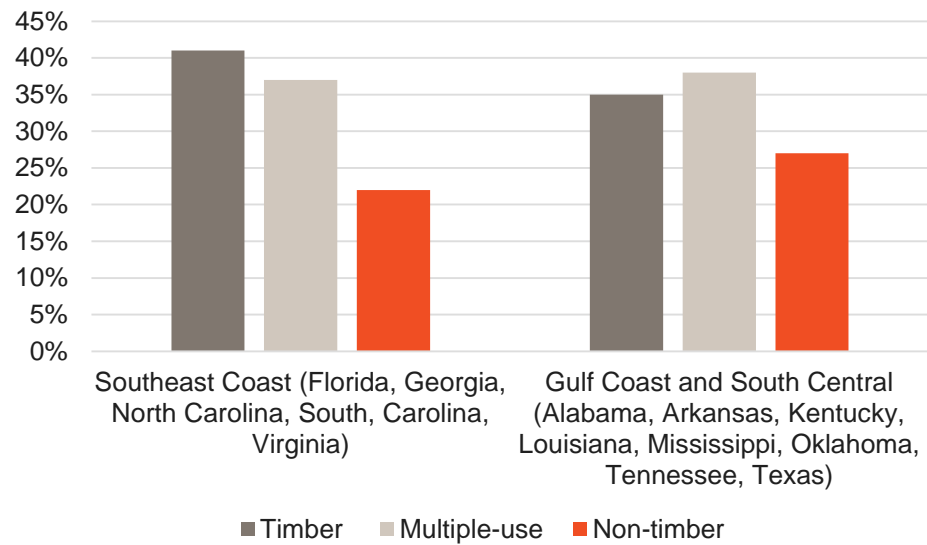


Figure 11. Ownership objectives of NIPF owners in the Southeast. Source: NWOS data as analysed by Kaezel (2011).

3.4.2 Contribution of NIPF characteristics to supply chain risk

Following from the above, while harvesting timber may not be an ownership objective of many family owners, this does often end up happening at some point, usually without having a formal written forest management plan, or with the landowner having received advice from a natural resource professional equipped to counsel the landowner on topics such as avoidance of high-grading, low-impact timber harvesting techniques, proper regeneration practices, or identification of rare species. In fact, only 5% have a written forest management plan, and 13% have received forest management advice from a natural resource professional (Wear & Greis, 2013), and NIPF owners generally are not currently participating in forest certification or other such programs.¹²

Volume of feedstock entering pellet mill supply chains from these forests may pose elevated risks in some areas. For instance, if a knowledgeable professional is not consulted to identify sensitive biodiversity resources, and/or a management plan written to inventory such areas, they may face increased likelihood of damage (Pan et al., 2007; Butler, 2008; Silver et al., 2015).

This challenge that many NIPF owners simply do not know what, if any, exceptional ecological values exist on their land, will likely always persist. This is

¹² For instance, Vlosky (2000) based on responses from over 800 family forest owners in Louisiana, report that (a) there is a perceived lack for a need to certify timber harvesting and management in privately-owned forests, (b) ambivalence on the capacity of forest certification programs to sustain the health of different ownership, and (c) pushes toward the adoption of certification on US forestlands is driven by NGOs rather than consumers.

usually not for lack of caring, but rather because a detailed resource assessment has not been conducted for their land. This may be due in large part to real/perceived costs, but more so because many family forest owners are not engaged in educational programs, let alone detailed forest planning and management.

For family forest owners, natural regeneration is also a common practice. Natural regeneration is the practice of establishing a forest stand following timber harvest by leaving seed trees, stumps for sprouting, or other regenerative conditions capable of adequately restocking the next forest without physically replanting trees. This is common in hardwood forests. For natural regeneration to work effectively, the residual stand needs to contain adequate spatial distribution of seed source (i.e. residual seed bearing trees) and/or sprouting stumps. When forests are high-graded by removing the most commercially valuable trees, the trees left are often of inferior quality, compromising the genetic content of the pursuant stand through unnatural selection. Simply letting the forest regenerate unassisted following a high-grading does occur, however, rates of this activity are unknown.

4 Regulatory and socio-economic environment

4.1 Relevant Federal Policies

While authority to enforce federal environmental laws usually rests with Federal agencies such as the US Environmental Protection Agency (EPA) and US Fish and Wildlife Service (USFWS), implementation of environmental laws is partially delegated to state agencies. State environmental laws often reinforce, clarify, and/or expand upon federal legal requirements. In addition, many states have laws prohibiting state-level policies from being more stringent than federal policies. The main federal laws influencing forest management on private lands in the US Southeast are briefly summarized in Table 4-1, two of which are explored in detail in this chapter because of their central relevance for forestry operations. In addition to these laws there are other laws that apply only to publicly held lands, such as National Forests (forests owned by the Federal government), which are unlikely to deliver significant quantities of biomass to the industrial pellet export market.

Table 4-1. Main federal laws related to the regulation of forestry in the US.

| Subject-matter | Law | Summary of the main requirements |
|---------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Water Quality | Clean Water Act (CWA) (P.L. 92-500 et seq.) ^A | The CWA generally prohibits the discharge of pollutants into waters of the US without a permit (section 402), including the discharge of dredge and fill material into wetlands. However, the discharge of both dredge and fill material from normal silviculture (forestry) activities, including the construction and maintenance of logging roads, and stormwater from these activities are exempt from federal CWA permitting requirements. Logging roads are exempt so long as best management practices (BMPs) are followed. Section 404 regulates forestry operation in wetlands, whereby there are 15 federally-mandated BMPs for road construction and 6 federally-mandated BMPs for site preparation which are set out in the US Code of Federal Regulations (40 CFR Part 232). Conversion of some designated forested wetlands to pine plantations requires a permit. |
| Species Protection and Recovery | Endangered Species Act (ESA) (P.L. 93-205 et seq.) ^B | The ESA generally prohibits actions, including habitat destruction or alteration on private land, that harm federally listed threatened and endangered species. Persons knowingly (civil crime) or wilfully (criminal crime) engaged in violations of endangered species law are subject to various penalties. |
| Species Protection | Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-712 et seq.) ^C | The MBTA generally prohibits actions that take (harm or kill) migratory birds designated for protection under the MBTA, unless the required permit is obtained. The taking of a bird covered by the Act is a strict liability offense and can be a crime. Federal agencies have been extremely reluctant to pursue incidental takes of migratory birds resulting from normal forestry and agricultural operations. Persons failing to comply with regulations regarding taking, killing, or possessing migratory birds subject to penalties. |

| | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Timber Trade | Lacey Act (16 U.S.C. 3371 et seq.) ^D | Since 2008, the Lacey Act prohibits the import, export, or sale of trees that have been harvested in contravention of any state or foreign law, including trees illegally harvested from protected areas. Persons importing, exporting, selling, or purchasing wildlife in violation of federal laws subject to civil and criminal penalties ranging from maximum of \$250 to \$20,000 and up to five years imprisonment. The Lacey Act applies to wood products imported into the US. This law does not require importers to maintain a chain-of-custody establishing sustainability. |
| Water Quality & Coastal Resources | Coastal Zone Management Act of 1972 (CZMA) (P.L. 92-583 et seq.) ^E | Influences land management and land use in coastal areas, including the development of comprehensive land management plans that identify actions for maintaining water quality associated with forests and wetlands. |
| Chemical Application | Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) (P.L. 61-152 et seq.) ^F | Regulates the labelling, registration, and use of chemicals commonly used in forestry (pesticides and herbicides). Persons failing to properly register or use pesticides subject to various penalties ranging from maximums of \$1,000 to \$25,000 and from maximums of 30 days to three years imprisonment |
| Forest Resource Monitoring and Planning | Forest & Rangeland Renewable Resources Planning Act of 1974 (RPA) (P.L. 93-378 et seq.) ^G | Authorizes long-range planning by the USDA Forest Service to ensure future supply of forest resources and environmental quality. RPA requires that a renewable resource assessment and a Forest Service plan be prepared every 5-10 years. |
| <p>A- http://www.gpo.gov/fdsys/pkg/STATUTE-86/pdf/STATUTE-86-Pg816.pdf B- http://uscode.house.gov/statutes/pl/93/205.pdf C- http://www.gpo.gov/fdsys/granule/USCODE-2010-title16/USCODE-2010-title16-chap7-subchap11-sec703 D- http://legcounsel.house.gov/Comps/Lacey%20Act%20Amendments%20of%201981.pdf E- http://www.gpo.gov/fdsys/pkg/STATUTE-86/pdf/STATUTE-86-Pg1280.pdf F- http://www.aq.senate.gov/download/fifra G- http://uscode.house.gov/statutes/pl/93/378.pdf</p> | | |

4.1.1 The Federal Clean Water Act

After urban stormwater and agriculture, improperly conducted logging operations and forest roads are among the most significant causes of nonpoint-source water quality impairment in the US. Improperly constructed or poorly maintained forest roads can be a significant contributor of sediments to waterbodies. Forestry operations are associated with around 10% of water quality impairments¹³ in the US, largely due to sedimentation associated with roads and stream crossings and the improper implementation of Best Management Practices (BMPs) (Edwards & Stuart, 2002). At the same time, forests are the best possible land use from a water quality perspective.

The Federal Clean Water Act (P.L. 92-500) is the most widely applied law in forestry in the US. Originally enacted in 1948 and revised in 1972, the focus of the Act is preventing and controlling water pollution from point sources (e.g. waste water treatment facilities), which are regulated through a permitting process, and nonpoint sources (i.e. not associated with a discernible point of discharge) such as forest harvest operations or forest roads.¹⁴ Implementation of the Clean Water Act occurs collaboratively between the US Environmental Protection Agency (EPA) and analogous state agencies. Another federal agency, the US Army Corps of Engineers (Corps) also plays an important role in the regulation of wetlands under the CWA.

Since 1987, the EPA has provided guidance to states on BMPs to control water pollution from nonpoint sources exempt from discharge permitting.¹⁵ While states are responsible for interpreting and implementing guidance on their own, the EPA provides a regulatory backstop as necessary, particularly concerning the use of forest roads and mechanical site preparation in wetlands. Summary information about Southeastern state water quality laws and BMP programs are available in *appendix B and C*.

The three sections of the Clean Water Act affecting forestry are:

- › Section 301. Specifies that discharges of pollutants (including sand, rock and other fill materials) into “waters of the United States”¹⁶ is unlawful except if it is in compliance with the provisions of the Clean Water Act.

13 The US EPA estimates that more than 40,000 waterways in the US are impaired, meaning that they are not meeting standards for water pollution <https://www.fas.org/sgp/crs/misc/R42883.pdf>.

14 See 40 CFR § 122.27(b)(1) for a definition of regulated point sources in forestry operations that require a discharge permit. <http://www.gpo.gov/fdsys/pkg/CFR-2011-title40-vol22/pdf/CFR-2011-title40-vol22-sec122-27.pdf>

15 See US EPA (2005) for examples of such guidance.

16 Waters of the US includes: All navigable waters, which are those waters that are, were or could be used in interstate or foreign commerce; all tributaries of navigable waters, which may include perennial or intermittent streams, modified streams or man-made ditches that discharge either directly or eventually into navigable waters; all impoundments of navigable waters or their tributaries, such as sounds, ponds or lakes; any wetlands adjacent to navigable waters or their tributaries. For regulatory

- › Section 401. Requires any applicant for a permit to discharge into waters of the US under the provisions of the Clean Water Act must receive approval from the state in which the discharge will occur.
- › Section 404. Focuses on the procedures for permitting discharges of dredged or fill material into waters of the US and provides information on activities for which permits are not required. Forestry is exempt from having to secure permits for discharging dredged or fill material, as cited within Section 404. However, there are several requirements that forestry activities must comply with in order to maintain this exemption. The Corps and EPA oversee regulations applying to section 404. Section 404(f) applies specifically to wetlands.

Except in a few instances described herein, silvicultural activities are exempt from permitting requirements regulating the discharge of pollutants and the dredge and fill of wetlands, under the condition that BMP programs are developed at the state level and that they follow EPA guidance.¹⁷ This was recently questioned in a high-profile federal court case (Decker v. Northwest Environmental Defense Center, 2013) after which the US Congress codified through new legislation¹⁸ that forestry activities are considered nonpoint sources of water pollution and are thus exempt from Clean Water Act point source permitting procedures. This legislative action also reinforced the long-standing approach of state-level forestry BMP programs.

Regulatory Frameworks governing the management of forested wetlands

The regulatory framework¹⁹ governing management of forested wetlands²⁰ focuses on controlling wetlands conversion through dredge, fill, and drainage activity. Federal and state wetland laws do not dictate vegetation management or silvicultural systems in wetlands; rather wetland law, principally section 404(f) of the Clean Water Act, focuses instead on alterations to wetland hydrology by purposeful drainage and/or infill.

purposes, the federal government and the states have established definitions of “waters of the US” and “waters of the state” respectively. In both cases “waters” also includes certain “wetlands” and streams.
17 As a regulatory agency, the EPA frequently issues guidance as a suggestive non-regulatory measure.

18 P.L. 113–79. <http://www.gpo.gov/fdsys/pkg/PLAW-113publ79/html/PLAW-113publ79.htm>.

19 An extensive review of federal wetland laws is available at:
<https://water.usgs.gov/nwsum/WSP2425/legislation.html>.

20 For the purposes of section 404(f) of the federal Clean Water Act, wetlands are defined in 33 CFR 328.3(b) “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.” States also have state-level definitions of wetlands and waters that tier from federal definitions.

Unless specified in water quality criteria under the federal Clean Water Act, in the federal Endangered Species Act, or by state law, regulation of forestry activities in wetlands in the US does not directly address the protection of biological functions in wetlands, but rather addresses water quality and hydrologic functions. Still, as discussed extensively in section 2.1.2 of this report, forested wetlands provide considerable habitat and biodiversity value. The EPA and the Corps are the two federal agencies with oversight on wetland regulations. The Corps is delegated the authority by the EPA to administer the wetland regulations that most commonly affect forestry.

Under section 404(f) of the Clean Water Act the Corps defines jurisdictional wetlands²¹, which fall under federal oversight. These are wetlands that are “hydrologically-connected” to “navigable waterways of the United States.” Given the geography of the South, there are extensive jurisdictional wetlands throughout the Coastal Plain. Non-jurisdictional wetlands are sometimes regulated under state statutes and some of these (e.g. vernal pools) hold great ecological value.

While other state or federal agencies may work with landowners to delineate jurisdictional wetlands, the Corps has ultimate authority to determine whether a wetland is jurisdictional or not. Water quality BMP programs in the South are typically designed to address the requirements of section 404(f) of the Clean Water Act and the specific requirements that enable an exemption of forestry activities in wetlands. There is a long history of legal debate around the status of this exemption but overtime it has been reinforced repeatedly (Spring, 1991).

Forestry operations are only exempt from section 404(f) permitting if such operations:

- › Do not permanently convert wetlands (through draining) into other land uses (i.e. not wetlands).
- › Do not immediately or gradually convert jurisdictional wetlands into non-jurisdictional wetlands through draining. See footnote 21 for the definition of jurisdictional and non-jurisdictional wetland.
- › Do not impair the flow or circulation or reduce the reach of “waters of the United States.”
- › Comply with federal BMPs that limit soil disturbance and hydrologic alterations during site preparation and other activities.

21 There is a three-stage test that the Corps uses to determine whether federal jurisdictional regulatory authority exists. To be considered a jurisdictional wetland the following conditions must be met: (1) the area must satisfy the three criteria for a ‘wetland’ as identified in the 1987 Corps of Engineers wetland delineation manual; (2) the area must be adjacent to a water of the US; (3) if the wetland is considered isolated, could the use, degradation or destruction of the wetland affect interstate or foreign commerce? In practice, a wetland that has a surface or channel hydrologic connection to a water of the US would typically be considered an adjacent wetland and therefore be a jurisdictional wetland.

Under the section 404 exemption, forestry operations can complete minimal and temporary “minor drainage”²² to lower the water table to enable timber harvests and regeneration for silvicultural operations that are “established and ongoing.” This is often practiced in the low-lying pine flats of the Coastal Plain. A silvicultural operation is considered established and ongoing when there is documented evidence that the property has been practicing forest management continuously and will continue forest management following harvest.

The “regeneration plan criterion” was a central point of focus in a court case (*Ogeechee-Canoochee Riverkeeper v. US Army Corps*, 2008) whereby the court eventually instructed the Georgia Forestry Commission to monitor regeneration. A common forestry practice is to allow bottomland hardwoods to regenerate through stump sprouts (i.e. coppice), which is considered inadequate by some (Conner et al., 2012). In [Ogeechee-Canoochee Riverkeeper v. US Army Corps](#) (2008) the court decided that the site be monitored as a provision for maintaining that the operation actually is an ongoing silvicultural operation.

As reinforced by various court cases (*Avoyelles Sportsmen's League v. Alexander*, 1979; *Avoyelles Sportsmen's League v. Marsh*, 1983), section 404(f) of the Clean Water Act specifies that properties are no longer considered established and ongoing silvicultural operations when they are converted to other uses through land clearing activities or when significant drainage would be needed to re-establish forestry operations. Other court cases have also emphasized the need for forestry practises that ensure regeneration in order to qualify for this exemption ([Ogeechee-Canoochee Riverkeeper v. US Army Corps](#), 2008). Still, a management plan stipulating measures for adequate regeneration can be considered evidence of ongoing use and continued forest management.

Up until the mid-1990s, large areas of forested wetlands on the Coastal Plain were converted to pine plantations through draining and intensive site preparation. A 1995 EPA memorandum²³ began requiring forestry activities to secure a section 404 dredge and fill permit if mechanical site preparation techniques are to be used in certain types of permanently flooded wetlands,²⁴ in part because the EPA wants to evaluate these on a case-by-case basis (US EPA, 2005). The silvicultural exemption is maintained in wetlands that are seasonally flooded, intermittently

22 Minor drainage for silvicultural purposes does not require as long as it does not result in the conversion of the wetland to upland. Under 33CFR323.4(a)(1)(iii)(C)(1)(ii) minor drainage means, “the discharge of dredged or fill material for the purpose of installing ditching or other such water control facilities incidental to planting, cultivating, protecting, or harvesting of rice, cranberries, or other wetland crop species, where these activities and the discharge occur in waters of the United States which are in established use for such agricultural and silvicultural wetland crop production.”

23 <http://water.epa.gov/lawsregs/guidance/wetlands/silv2.cfm>.

24 These wetlands types include: Permanently flooded wetlands, intermittently exposed wetlands, and semi-permanently flooded wetlands; Riverine Bottomland Hardwood wetlands; White Cedar Swamps; Carolina Bay wetlands; Non-riverine forest wetlands; Low Pocosin wetlands; Wet Marl Forests; Tidal Freshwater Marshes; and, Maritime Grasslands, Shrub Swamps, and Swamp Forests. Further guidance is provided in US EPA (2005).

flooded, temporarily flooded; water saturated, or occurs in existing pine plantations, provided that EPA-specified BMPs for site preparation are followed.

EPA developed mandatory wetland BMPs to address “the potential to cause effects such as soil compaction, turbidity, erosion, and hydrologic modifications if the activities are not effectively controlled by BMPs,” (US EPA, 2005). Additionally, EPA requires that 15 BMPs be used when constructing or maintaining roads in forested wetlands. Additional federal requirements will typically induce states to modify BMP programs. That the Southeast has the most cases in which BMPs are considered “*regulatory under certain instances*,” is owed in large part to the extensive wetlands throughout the region, which upon harvesting trigger these 15 federally-mandated BMPs (Ellefson et al., 2004).

4.1.2 The Federal Endangered Species Act

Two-thirds of imperilled species in the US live on privately owned land. In the Southeast, such species, like the red-cockaded woodpecker, have significant amounts of habitat on private land.

The federal Endangered Species Act²⁵ (P.L. 93-205 et seq.)²⁶ (ESA) was enacted in 1973 to protect and recover imperilled species and the ecosystems upon which they depend. At the federal level the US Fish and Wildlife Service (US FWS) is responsible for all terrestrial and freshwater species and the National Oceanic and Atmospheric Administration Marine Fisheries Service is responsible for fish and wildlife that spend at least part of their lifecycle in oceanic environments.

Under this law, species are listed (added to a list of other imperilled species) as being either endangered (on the brink of extinction) or threatened (likely to become endangered) within the foreseeable future. Any species, except pest insects, is eligible for listing if its habitat is presently threatened with destruction, modification, or curtailment; if the species or its habitat is determined to be over-utilized for commercial, recreational, scientific, or educational purposes; if the species is under threat of extinction due to disease or predation; if existing regulations and protections are deemed inadequate to protect the species; or if other natural or man-made factors threaten its existence.

Regulations under the ESA are largely administered at the federal level. The ESA includes processes for listing candidate species and protecting threatened and endangered (T&E) species and their habitats from damages. Listing a new species is a complex science-driven process often involving the extensive assessment of the status and threats for each species (Corn et al., 2013). In addition to listing threatened or endangered species, the US Fish and Wildlife Service maintains a list of “candidate” species for which enough is known to propose the species for listing once other priority species listings are completed. The US FWS works with states to encourage conservation of candidate species but has little authority, or budget, to advance protections on their own.

25 <http://www.fws.gov/endangered/laws-policies/index.html>

26 <http://www.epw.senate.gov/esa73.pdf>

Each southern state has at least one law that mirrors the federal ESA. Most of these laws are aimed at reinforcing the ESA by listing species at the state level. Summary information for state-level biodiversity conservation policies is included in Appendix B.

Table 4-2. Threatened and endangered animals and plants in southern states.

| | Number of Threatened & Endangered Animals | Number of Threatened & Endangered Plants |
|-----------------------|-------------------------------------------|------------------------------------------|
| Alabama | 108 | 22 |
| Arkansas | 31 | 5 |
| Florida | 70 | 59 |
| Georgia | 43 | 26 |
| Kentucky | 36 | 10 |
| Louisiana | 24 | 3 |
| Mississippi | 43 | 4 |
| North Carolina | 39 | 27 |
| Oklahoma | 22 | 3 |
| South Carolina | 22 | 21 |
| Tennessee | 72 | 21 |
| Texas | 69 | 31 |
| Virginia | 58 | 18 |

A key regulatory aspect of the ESA as administered by the US Fish and Wildlife Service is a permit program that enables the lawful take of species when it cannot be avoided (e.g. if a parcel supporting known T&E habitat must be developed as part of an infrastructure project).²⁷ Mechanisms exist to “take”²⁸ a T&E species or its habitat and still comply with the ESA:

- › Under the law, state and local governments and private landowners may be given a permit to knowingly take a T&E species if they develop habitat conservation plans (HCPs) which assess the likely impacts on the species from the proposed action (e.g. a pipeline) and outline steps (including requisite

²⁷ It is important to note that in such instance additional state and federal environmental review laws apply. If such projects use federal funding they may be subject to intensive environmental analysis via the National Environmental Policy Act (NEPA).

²⁸ “take” means “to harass, harm, pursue, hunt, shoot, wound, kill, trap capture, or collect, or to attempt to engage in any such conduct.” 16 U.S.C. § 1531(19). The U.S. Supreme Court upheld the Secretary of interior’s definition of “harm”: an act, including “significant habitat modification or degradation . . . which actually kills or injures wildlife.”

funding) that the permit holder will utilize to avoid, minimize, and mitigate the impacts.

- › Focused on restoring and maintaining species habitat, Safe Harbor Agreements (SHAs) provide regulatory assurance for private landowners who voluntarily assist in implementing a T&E species' recovery plan on their property. Under SHAs, landowners manage the enrolled property and may return it to originally agreed-upon conditions for the species and its habitat at the end of the agreement, even if this means incidentally taking the species.
- › Candidate Conservation Agreements (CCAs) and Candidate Conservation Agreements with Assurances (CCAAs) are another mechanism whereby the ESA engages private landowners to develop conservation plans for the candidate species on their property. CCAAs take this concept one step further, providing "regulatory shelter" from future listing of the candidate species, provided that landowners stick to the details of their agreement. Section 6 of the ESA contains provisions for states to enter into agreements with the US Fish and Wildlife Service. While funding varies by legislative appropriations, Section 6 authorizes the use of federal funds to assist states in the conservation of T&E species.
- › ESA conservation banks are parcels that permanently protect species habitat as mitigation for the loss of listed species elsewhere. This action generates mitigation credits which can be sold to others needing to mitigate a permitted taking elsewhere of that same species. The concept is intended to benefit species by improving the retention of large intact habitats rather than producing several small, disconnected habitats over time. The value of species banks can be significant but transaction costs can be limiting.

Forestry operations and landowners must comply with ESA regulations if T&E species are present on their property. If candidate species are known to occur on the property, then the landowner is encouraged to implement conservation activities. The ESA has potentially significant implications for individual landowners and entire regions. First, anyone taking a listed species without a permit issued by the US FWS can be criminally prosecuted and face \$25,000 in fines, potential incarceration, and property forfeiture. This applies to corporate, public, and NIPF lands alike. Second, there is precedent²⁹ for species listings to have significant effects for forest industries and landowners on a regional scale.

Implications of the ESA for forestry operations in the Southeast

ESA regulatory mechanisms apply only when T&E species are detected on a given property. Thus, these species have to be known to occur or discovered before forestry operations commence, creating a disincentive for landowners to have their lands surveyed for such species to begin with. The ESA does not require that landowners survey their property for rare or T&E species prior to beginning forest

29 The listing of the Northern Spotted Owl, several Salmonids, and other species has had significant effects on the forest sector on the US West Coast.

management activities which could have a direct impact on these species if they are present.

Given the significant presence of T&E species throughout the US South, reputable forest management companies have integrated species management including compliance with the ESA into land management. There are good examples of forest management planning to identify rare habitats and element occurrences of T&E species, including Habitat Conservation Plans developed by forest products companies. Formal agreements of this kind rely on identification and notification, so when landowners, particularly NIPF owners, conduct management without consulting a professional knowledgeable on species conservation and referencing proper information sources (e.g. natureserve.org and/or state Natural Heritage programs); the intent of the law erodes.

As discussed elsewhere in this report, a majority of NIPF owners do not receive advice before completing a timber harvest and even fewer develop a management plan, which may or may not identify measures to address T&E species and other species of concern. Additionally, proactive measures to promote species conservation in advance of those species becoming threatened or endangered may not be consistent with the management objectives or inclinations of private landowners.

Remnants of longleaf pine stands and forested wetlands are two habitat types on the Southeast Coastal Plain that are of particular concern, due to their relatively high biodiversity and predominance on private lands. While T&E species may be present on some parcels, without an ecological inventory their protection under the ESA does not apply. Conservation of this habitat is now a uniform priority for state and federal agencies, NGOs, and others throughout the region, and its protection is reliant upon the cognizance and due diligence of landowners. This in part explains concerns often expressed by NGOs about the relative risk of forest type conversion.

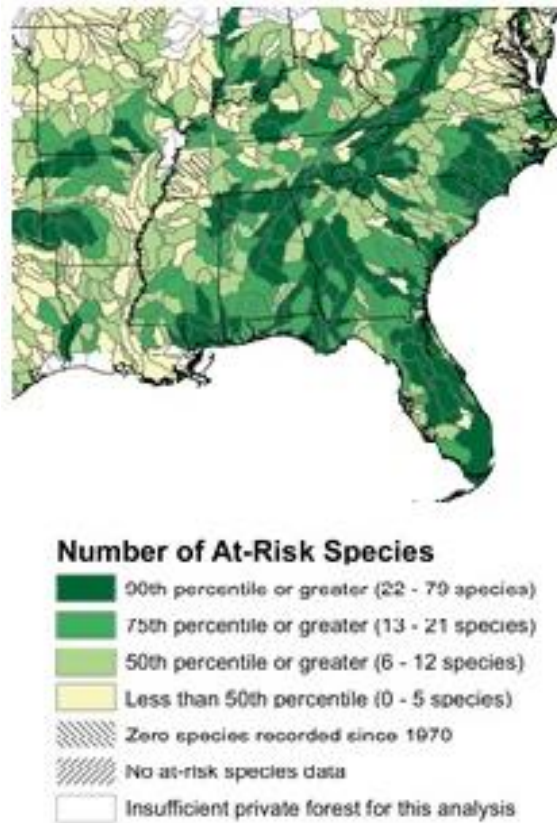


Figure 12. Number of at-risk species per watershed. Source: Stein et al. (2010).

Many forest owners fear what the presence of T&E species could mean for their property and economic opportunities and the forest industry shares this sentiment.³⁰ Indeed, there are documented cases of unlawful destruction of habitat by accelerating timber harvests to discourage or eliminate species such as the red-cockaded woodpecker or Florida panther when the ESA was first enacted (Logan, 2007). Given the sensitivities around T&E species, environmental NGOs have been successful in delaying or stopping logging on private lands if they can prove a realistic potential that logging activities will directly affect a known occurrence of a T&E species.³¹

Another important provision of the ESA prohibits federal agencies from taking actions likely to adversely affect “critical habitat” of T&E species.³² According to 2014 rules introduced by the US FWS, critical habitat represents the habitat essential for a species’ recovery. The ESA requires, with few exceptions, that critical habitat be designated for species that are protected under the act. Critical habitat designations do not create reserves or protected areas, but federal agencies are required to consult with the US FWS to ensure that any actions they

30 North Carolina Forestry Association comments on the ESA listing of the Northern Long-Eared Bat as threatened Forest Resource Association.

31 For example, Seattle Audubon Society v. Sutherland, No. 06-1608, 2007 WL 2220256 (W.D. Wash. Aug. 1, 2007)

32 Up to date data on critical habitat can be accessed from the US FWS here: <http://criticalhabitat.fws.gov/crithab/>.

authorize, fund, or carry out are not likely to result in the “destruction or adverse modification”³³ of designated critical habitat.

Rule-making by the US FWS has attempted to clarify and reinforce what critical habitat is and when critical habitat protections apply. There continues to be considerable debate about what constitutes a species’ “range,” and these debates extends to the designation of critical habitat (Endres, 2012). As such, designations of critical habitat, and the species-by-species focus of the ESA more generally, does not necessarily encompass larger geographies important for maintenance of biodiversity. In the Southeast, much of the identified critical habitat occurs in river systems associated with T&E fish and freshwater mussels. In these areas, riparian forests have direct effects on the instream aquatics deemed as critical habitat.

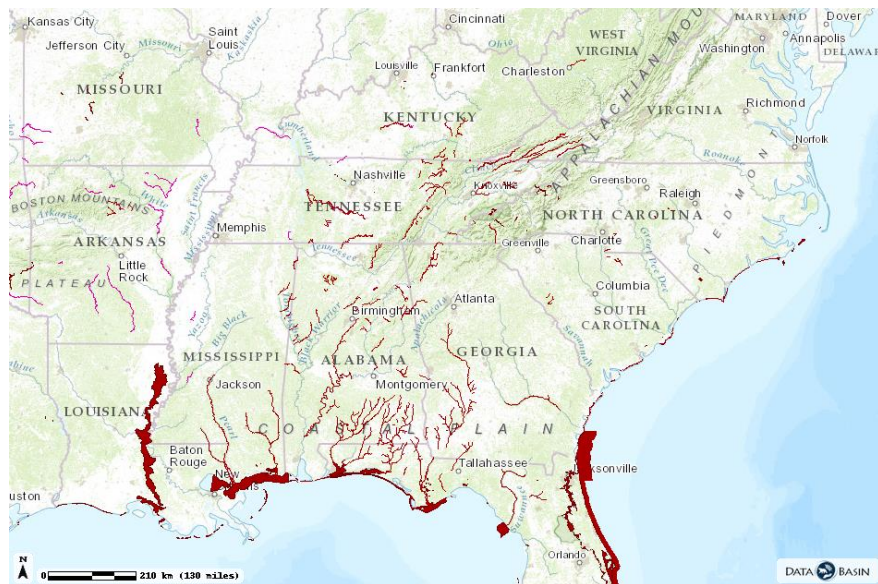


Figure 13. Critical habitat as designated by the US FWS in the southeast US. Source: Databasin.org; US FWS.

Lastly, under the ESA, if there is a nexus to federal funding, either through state forestry agencies or federal assistance programs, for developing or implementing a management plan for instance, the ESA is to be followed by private landowners. This is disclosed to landowners upon program enrolment but does not bind the landowner to completing detailed ecological surveys of their land.

Conservation of species and habitats not covered under the ESA

Commonly viewed as a weakness of what is generally a very stringent law, the ESA is for the most part retroactive, focusing on the protection and recovery of species which have become imperilled rather than proactively preventing additional

33 “Destruction or adverse modification” means a direct or indirect alteration that appreciably diminishes the conservation value of critical habitat for listed species. Such alterations may include, but are not limited to, effects that preclude or significantly delay the development of the physical or biological features that support the life-history needs of the species for recovery.

species from becoming imperilled. This is often cited as a problem because of the large number of species of concern, which could become threatened and endangered due to cumulative impacts.

The state of Georgia, for instance, currently has 69 listed T&E species yet the Georgia State Wildlife Action Plan (SWAP)—the state’s de facto biodiversity conservation roadmap—identifies 162 high priority species of concern in just the Coastal Plain. This situation is not a unique to Georgia and is precisely the impetus for a recent study (Evans et al., 2013a) examining potential pressures that a growing industrial wood pellet sector could exert on habitats and species of concern, many of which are included in SWAPs.

Another challenge is related to the identification and mapping of T&E species occurrence. Typically, such information is not forced upon private landowners. Private landowners are generally not required under federal or state laws to survey their land for T&E species prior to undertaking timber harvests. Forest management certifications and other sourcing programs either encourage or require landowners to do so.

Much of the remainder of this chapter discusses these and related approaches to biodiversity conservation, focusing mainly on soft policies (non-regulatory incentives) frequently used in the Southeast US.

Information resources supporting biodiversity conservation

Federal agencies contribute significant amounts of data and are responsible for conducting research on the status and trends of ecosystem health across the US. The USDA Forest Service Southern Research Station and USDA Forest Service FIA Program and Spatial Analysis Project provide critical information resources on forest conditions and trends. The US FWS’ National Wetlands Inventory and USDA Natural Resource Conservation Service’s Natural Resources Inventory are responsible for monitoring the status and trends of the nation’s wetlands. Likewise, the United States Geological Survey (USGS) Biological Resources Division coordinated the Gap Analysis Program³⁴, which identifies gaps in biodiversity protection via spatial analysis. The USGS also monitors trends in carbon storage and land cover change using various remotely sensed data sets. More recently, federal agencies have collaborated with states and NGOs via Landscape Conservation Cooperatives, which includes the pellet export region.³⁵

Additionally, state agencies, universities, and NGOs (e.g. the Audubon Society’s Breeding Bird Surveys) collect large quantities of biological data, which are often organized and accessible at the state level through State Natural Heritage Programs and through NatureServe.org. These data resources comprise a large proportion of the available information on ecosystems and biodiversity in the US. Thus, they are an important resource when determining whether species are listed, or whether there are occurrences of rare species and community types or species of concern, on lands subject to sourcing by wood product facilities.

34 <http://gapanalysis.usgs.gov/data/>

35 <https://nccwsc.usgs.gov/content/landscape-conservation-cooperatives-lccs>

Information resources discussed above are publicly available and have been integrated into state-level strategies for forestland conservation and stewardship, i.e. Forest Resource Assessment and Strategies (FRAS), and strategies for biodiversity conservation, i.e. State Wildlife Action Plans (SWAPs). All states in the South have developed FRAS and SWAP documents (see appendix B), but do vary in their level of detail and utility as a planning/strategy documents. Many states have limited mapping of priority areas with strategy documents mostly containing written narratives.

Regardless of their detail and usefulness, these documents are intended to guide natural resource management agencies and the constituencies they serve, such as foresters, landowners and conservation organizations. Depending on appropriations from the federal government, states may also receive federal funding to assist with implementing these conservation strategies.

These plans also prioritize conservation efforts to areas prone to development. Direct technical assistance—helping landowners create management plans, providing cost-share for forest management activities, and giving advice/guidance, is a main strategy identified in these FRAS action plans. This approach may have variable success rates. As found by a recent research concluding that *“regardless of the type of assistance received, assisted landowners are generally no less likely to sell or subdivide their land than those who have not received assistance,”* (Kilgore et al. 2015).

Conservation easements are another approach in which landowners forego their rights to development.³⁶ These can be structured as working forest easements aimed at maintaining timber production. However, the Southeast contains the smallest area protected by conservation easements (7.8%) in the US (Jenkins et al. 2015). The low impact of these strategies no doubt contributes to the promotion of timber markets are the pre-eminent mechanism keeping land in forest across the region.

4.2 State Policy

In addition to key federal laws, state policies add requirements that influence forest land management³⁷ activities. Private property rights are strongly held in the US and especially the Southeast. Associated with this is a reluctance to impose regulations that would be perceived to unreasonably encumber land use and management decisions. State property rights laws can make it challenging for states to adopt new or even implement existing environmental laws (Environmental Law Institute, 2013).

In surveys of Southern State forestry agencies, regulatory programs are consistently ranked as the least effective means to improve forestry practices

³⁶ Working forest easements are a class of conservation easement which protects land from development while still enabling sustainable production of timber through forestry.

³⁷ There is a long-standing legal precedent that the US EPA does not directly regulate land management activities.

(Kilgore & Blinn 2004). Another factor influencing whether regulations, such as permit programs and/or harvest inspections, are effective, is the limited capacity and funding of state agencies, relative to the number of landowners engaged in forest management.

In the Southeast US, there are no mandatory prescriptions on the size of clear-cuts, cutblock design, or retention of legacy features (e.g. snags, dead and downed trees, or mast producing trees providing food source for wildlife) in any state or federal regulation applying to forestry. Voluntary forest management certifications, however, do place limits on openings and in some instances encourage retention of legacy features.

Regulation of land use and forestry practices is more common in states with “Forest Practices Act” regulations, which usually require permitting, inspection, monitoring, and reporting of performance on issues beyond water quality. Examples of states that have very extensive forestry laws include the Forest Practices Act regulations of California and Washington, the Managed Forest Law of Wisconsin, the Massachusetts Forest Cutting Practices Act.³⁸ Nationwide, state-level Forest Practices Act laws tend to include a wider range of requirements addressing more than water quality and Clean Water Act compliance.

Approaches relied on in the Southeast for ensuring implementation of BMPs ranges from regulatory (silvicultural BMP legislation) to non-regulatory (voluntary adoption and promotion of the use of BMPs through training and education) (see appendix B for an explanation of each state program). Research has shown that all program structures can be effective in achieving environmental outcomes (NASF, 2015).³⁹ Moreover, that BMPs can be effective in controlling sedimentation and other pollutants from forestry operations (Anderson & Lockaby, 2011; Ice et al., 2004; Shepard et al., 2004; Aust & Blinn, 2004).

As a region, the Southeast has fewer regulations on forestry practices (Ellefson et al., 2004). Figure 14 depicts the involvement of agencies (as a percentage of the total) in the regulation of forest practices on private land in the US South. About a third of common forestry practices in the South are regulated conditionally. For example, in Virginia regulations are only imposed on those landowners or loggers who have already committed (or are in the process of committing) violations, although requirements to notify when harvesting is occurring do exist.

38 California Forest Practices Act: http://calfire.ca.gov/resource_mgt/resource_mgt_forestpractice.php.

Washington Forest Practices Act: <http://apps.leg.wa.gov/rcw/default.aspx?cite=76.09>.

Wisconsin Forest Practice Guidelines: <http://dnr.wi.gov/topic/ForestManagement/guidelines.html>

Massachusetts Forest Cutting Practices Act:

<http://www.mass.gov/eea/docs/dcr/stewardship/forestry/ch132law.doc>.

39 The National Association of State Foresters found minimal difference in BMP implementation rates among forestry NPS programs that are regulatory (93.4%), quasi-regulatory (90.3%), and non-regulatory (90.2%) (NASF, 2015).

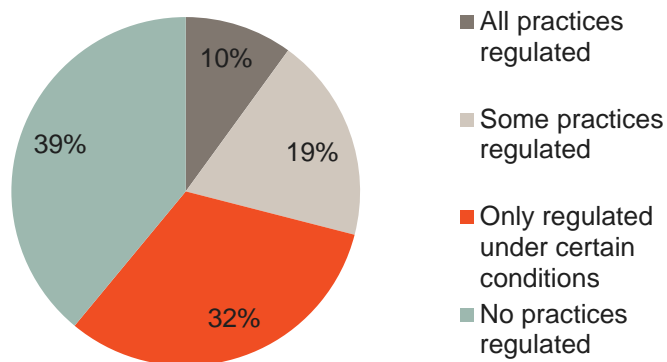


Figure 14. Regulation of forestry practices in the US South as a percentage of the total amount of harvesting practices and BMPs implemented, as reported by state forestry agencies. Source: Ellefson et al. 2004.

Table 4-3. Southern states in which forestry practices are always or often correctly applied as reported by state agency personnel overseeing implementation of practices.

| | Number of southern states reporting practices as always or often correctly applied | All or some practices are regulated: <i>Portion reported as being always/often correctly applied</i> | Regulations only under certain conditions: <i>Portion reported as being always/often correctly applied</i> | Practices Not Regulated: <i>Portion reported as being always/often correctly applied</i> |
|---------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Road and Trail Practices | 12 | 50% | 33% | 17% |
| Timber Harvesting Practices | 12 | 33% | 50% | 17% |
| Reforestation Practices | 12 | 17% | 33% | 50% |
| Silvicultural Practices | 9 | - | 44% | 55% |
| Chemical Application Practices | 11 | 55% | 27% | 18% |
| Forest Protection Practices | 5 | 20% | 40% | 40% |
| Administrative Practices | 7 | 14% | 14% | 72% |

Regulatory approaches (e.g., procedural rules, legislatively prescribed practices, harvest notification requirements, inspections, compliance actions, and enforcement) and non-regulatory approaches (e.g., extension education, information sharing networks, technical assistance, tax incentives, and other financial incentives), can both be useful means of attaining desired outcomes. Often regulatory and non-regulatory approaches work best in concert with each other. A comprehensive review of literature on approaches that led NIPF landowners to implement sustainable forest management practices found three approaches that work consistently—technical assistance, financial assistance, and putting landowners in direct contact with foresters.

Aguilar & Saunders (2011) evaluated the capacity of selected public policy instruments (namely, tax incentives, subsidies and grants, rules and regulations, education and consultation) to meet policy objectives. Those from the Southeast US had less favourable views of subsidies and grants, and rules and regulations than respondents from the rest of the country, as means to meeting policy objectives.

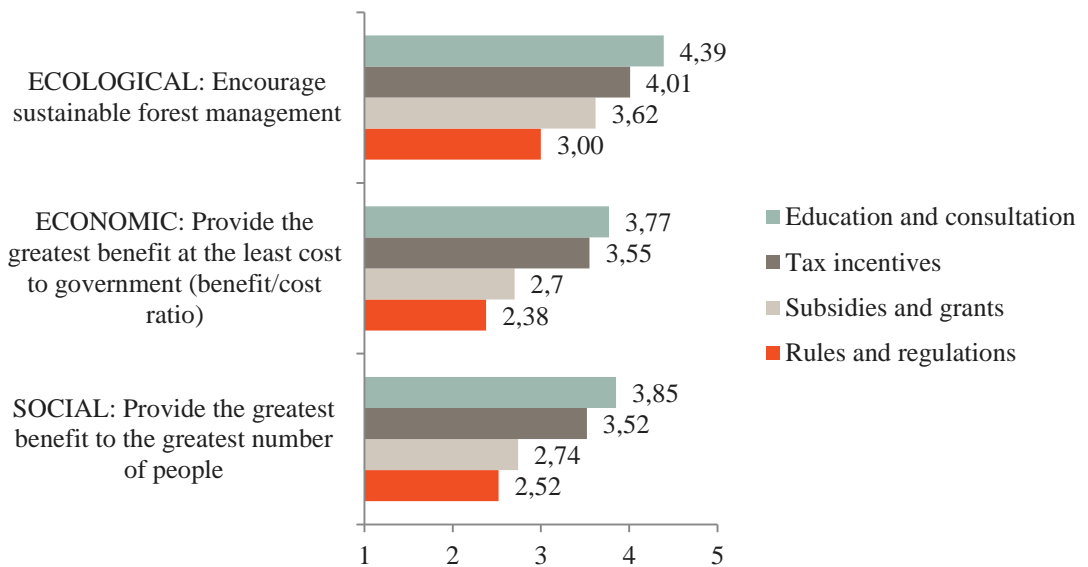


Figure 15. Mean responses to ecological, economic and social policy evaluation criteria elicited using 1-5 Likert scale (1 = strongly disagree, 3 = neither agree nor disagree, 5 = strongly agree). Source: Aguilar & Saunders (2011).

Another type of oversight states may use is licensing and/or programs of professional certification, which can apply to loggers and foresters.⁴⁰ These programs dovetail with training and education programs in most states, as well as regulatory approaches in some (e.g. Kentucky). Additionally, they are important benchmarks for certification standards. The intent of licensing programs is to help protect the public interest, ensure economic values are maintained for the timber owner, and assure that practices such as reforestation are implemented. A primary example is the Society of American Forester’s Certified Forester Program, which requires participants to obtain a professional degree in forestry, have five years of relevant experience, and participate in continuing education (attendance to trainings and technical workshops).

Arkansas, Georgia, Mississippi, North Carolina, and South Carolina maintain mandatory registration of foresters, while Alabama is the only state in the South that requires licensing (Ellefson et al., 2012). To be registered as a forester, general basic education in forestry is required, which may include registration with the Society of American Foresters. A forester typically completes a range of services and offers landowners consultation on a range of topics, which may include: timber harvesting and BMP layout, regeneration, timber inventory and appraisal, conservation practices, and management planning. On any given harvest across the South, a landowner may or may not elect to work with a forester and while loggers are required to license their business, this licensing does not require any level of proficiency in appropriate logging practices and equipment. Loggers typically are responsible for BMP implementation and timber harvesting.

40 Interestingly, as an important actor in the supply chains of the South, wood dealers are not licensed, although this done in other regions of the country.

In addition to the state and federal laws influencing how forestry is conducted⁴¹, land use laws (e.g. zoning and property taxation) are promulgated and enforced by county and municipal governments (local governments), sometimes controlling where and how forestry is practiced. Where state forestry laws are limited, local governments in some places have created regulations curtailing forestry activities (e.g. clearcutting) through local ordinances. As of 2000, there were a total of 346 forest-related laws developed at the local-level in southern states (Wear & Greis, 2002).

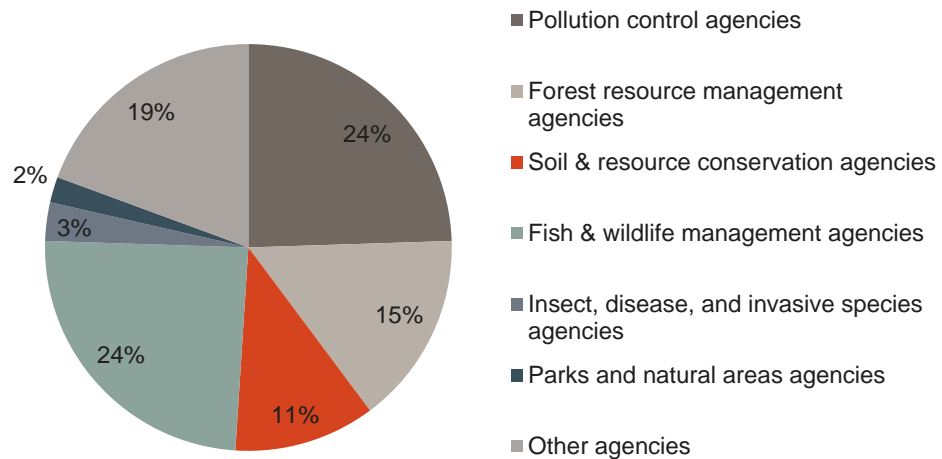


Figure 16. Involvement of government agencies (as a percentage of the total) in the regulation of forest practices on private land in the US South. Source: Ellefson, 2004.

State water quality BMP programs

Ellefson et al. (2004) identified 37 states that have additional water quality laws in addition to the Clean Water Act that apply to forest operations. These laws outline the means by which states comply with the federal Clean Water Act such as defining regulatory authority related to BMP programs. Appendix B includes an overview of these state laws in the US South as well as information related to the rate of implementation of BMPs in southern states. Appendix C include a comparison of southern state BMP programs to a slightly modified version of the Montreal process Criteria and Indicators.

Forestry BMPs are designed to reduce risk of sedimentation from forestry operation, reduce soil disturbance, facilitate rapid regeneration, and control overland sheet flow of water (Aust & Blinn, 2004). Proper implementation of BMPs also involves proactively planning forest management activities (e.g. harvest layout, road design, etc.) in a manner that minimizes negative impacts to water quality, forest soils, and forest productivity. The Southern Group of State Foresters has organized BMPs in Southeastern state programs into seven categories: harvesting, forest roads, stream crossings, streamside management zones

⁴¹ There is a long-standing legal precedent that the US EPA does not directly regulate land management activities.

(riparian buffers), site preparation, firebreaks, and chemical application (SGSF, 2012).

When properly implemented, forestry BMPs are considered a cost-effective method of controlling water pollution and have been found to reduce net revenue of timber harvests in the South by only 2.9%-5.1% (Lickwar et al., 1992). Scientific research has documented that when BMPs are correctly applied, short-term damages can be limited and successfully mitigated. Likewise, with proper implementation of wetland BMPs, the alteration of wetland hydrology can be minimal (Sun et al., 2001).

Research has found certain BMPs to be the most effective in protecting water quality when they include: (1) careful planning and construction of roads, skid trails, stream crossings, logging decks and exits onto paved roads, (2) protection of bare soil, (3) provisions for revegetating harvested areas and temporary roads as quickly as possible, (4) provisions for implementation of streamside management zones (SMZs) (Aust & Blinn, 2004). While there is variability in state regulatory programs, these core effective BMPs are generally the focus of most state BMP manuals (Neary et al., 2009).

BMP program structure and implementation rates

BMP programs can be classified as regulatory, non-regulatory (voluntary), or as combining regulatory and non-regulatory aspects. Regulatory programs often involve some permitting or harvest notification processes, inspections, and enforcement. Both approaches appear to be effective in inducing BMP compliance, and while costs can vary, at least one study comparing what at the time was largely a non-regulatory approach in Virginia, to Maryland, a more regulatory state, found only a marginal increase in expense with the more regulatory approach (Hawks et al., 1993). Conversely, others evaluating alternative regulatory designs for Virginia found that significantly greater cost would likely be incurred with only marginal environmental benefits (Aust et al., 1996).

In all program types, education and training of loggers, is an important part of ensuring that BMPs are properly implemented (Shaffer & Meade, 1997). See Appendix B for a determination of which BMP programs are considered regulatory and which are considered non-regulatory in Southeastern states, as well as information on reported rates of BMP compliance. Each state has an instructional BMP manual and these vary in their level of specificity for how practices are to be implemented and generally offer more precise direction for practices related to regulatory issues, such as harvesting in forested wetlands.

A nationwide 2014 BMP survey found that BMP implementation rates range from over 80 – 95% (see Appendix B).⁴² Since the 1980s when BMPs were first introduced, implementation rates have steadily increased to the point where BMPs are now more-or-less standard operating procedures. BMP implementation is monitored by state forestry agencies. The Southern Group of State Foresters recommends a monitoring protocol but states have the flexibility to monitor using

⁴² <http://www.stateforesters.org/current-issues-and-policy/current-issues/water-quality-and-bmps>.

their own methods (SGSF, 2007). While water quality BMP programs in the Southeast are largely non-regulatory or partially regulatory, surveys indicate an overall compliance rate of 92% (SGSF, 2012). This is an increased rate of implementation compared to that identified in previous surveys by the Southern Group of State Foresters and by Ellefson et al. (2004). Implementation rates and the proper application of BMP’s have improved substantially over the last decade through programs of outreach and training supported by certification requirements.

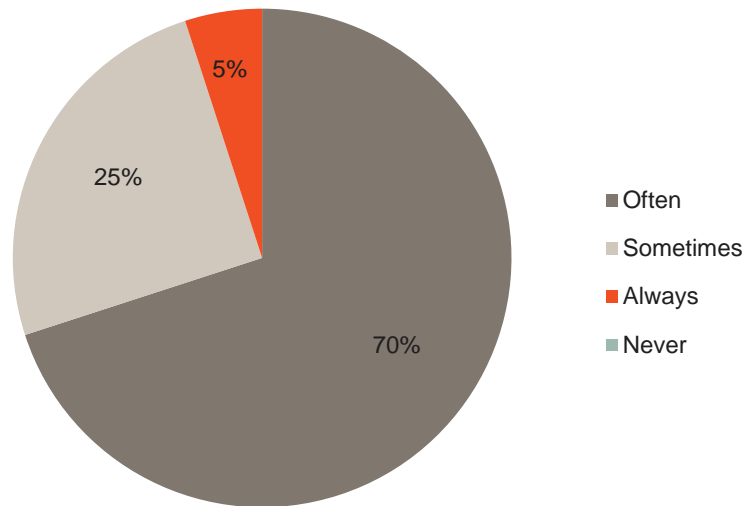


Figure 17. Percentage of time all forest practices are correctly implemented on private land. Source: Ellefson et al. (2004).

Across the Southeast, forest management policies and programs generally do not directly address risks to biodiversity in a holistic manner, because state policies revolve around water quality protection primarily. In addition, BMPs are not intended to prevent or reduce conversion of natural forest to plantation forest.

The non-regulatory bias, and silvicultural exemptions for forestry in the South, owe to a perception that forestry is a beneficial industry and a strong feeling that regulatory approaches are a challenge to enforce, antagonistic, and less effective when engaging forest landowners. This perception is not universally held and is increasingly being challenged by advocacy organizations. However, this perception underlies the design of BMP programs and the predominant approaches to promoting forest stewardship and biodiversity conservation on private lands in the region.

Technical and financial assistance, landowner outreach, and logger education programs are the dominant forms of non-regulatory approaches taken. Similarly, Kilgore & Blinn (2004) found technical assistance from natural resource professionals to be the most effective way to encourage NIPF owners to apply sustainable practices, followed by cost-share programs. Research has also linked landowner willingness to harvest to the outreach and assistance they receive (Silver et al., 2015; Joshi et al., 2013). Still, the level of technical assistance needed to induce sustainable management practices varies, with some landowners requiring at least three different forms of assistance (cost-share payments, one-on-

one consultation with a forester, regulatory assurances) before sustainable management is undertaken (Kilgore et al., 2015).

A recent analysis of the National Woodland Owners Survey (NWOS) database evaluated NIPF owner engagement and stewardship activities on ownerships of 10–999 acres (Kilgore et al., 2015). Of this statistically valid sample of family woodland owners, 34% (1,239 landowners) had received professional advice (technical assistance) and 14% (518 landowners) had received financial assistance. Of all landowners surveyed, the majority had harvested timber (63%) while 23% considered timber to be a primary objective of land ownership, and only 22% has planned timber harvests in the future.

The analysis also confirmed the conventional wisdom that a heavily assisted landowner (i.e. who has developed a forest stewardship plan, and received cost-share assistance and advice) is more likely to do things commonly associated with forest stewardship than those receiving only a single type of assistance. The analysis concludes that it may take significant assistance in multiple forms to yield a stewardship result. In addition, it was discovered that landowners are more likely to harvest timber after they have received assistance (Kilgore et al., 2015; Hoyt, 2008).

4.3 Relevant federal, state, and private incentive programs

USDA Forest Service Forest Stewardship Program

Preparation of a forest stewardship plan is often the first step toward sustainable forest management for small woodlot owners. It allows technical assistance providers to begin to build a relationship with landowners and work with them to adopt other conservation measures. It is a pre-requisite for receiving a federal cost-share for implementing silvicultural activities (e.g. pre-commercial thinning).

The Forest Stewardship Program is one of several forms of federal financial and technical assistance available to all NIPF owners for completing a plan. The program provides financial compensation to landowners who work with a forester to develop forest stewardship plans. The USDA NRCS also has cost-share funds available to provide financial assistance to landowners to complete a plan. The Program is administered by the USDA Forest Service in cooperation with state agencies.

The presence of a plan has been found to be the most important factor influencing NIPF owners' decisions to work with a forester when harvesting timber and planting trees. Yet, only 5%⁴³ of NIPF owners in the South have a written management plan (Zhang & Mehmood, 2001).

⁴³ This 5% of all NIPF lands control 21% of the private forest acreage in the South.

Plans are usually written by a professional forester and cover a 10–15 year period by a licensed professional forester and typically include: (1) an articulation of the objectives of the woodland owner, (2) forest inventory data, (3) maps denoting relevant property-specific information (e.g., location, boundaries, individual stands, soil types, tree retention areas, key conservation features, and future harvest areas), and (4) detailed descriptions and chronology of silvicultural treatments for each forest stand. Many state and federal financial incentives, and Farm Bill programs,⁴⁴ require that landowners operate under a current FMP.

Overall, coverage of FSP in the Southeast is limited (see Table 4-4). The program covered just over 1.65 million hectares (4.1 million acres), or roughly 3% of all NIPF lands in the south as of 2010. Interestingly, analysis of a state program in Minnesota to promote adoption of forest management plans and related stewardship activities found that some landowners will participate at a lower level of financial assistance, but to secure a substantial amount of family woodlot owners at least \$24/acre per year was needed to engage 50% of the owners surveyed (Kilgore et al., 2008). It is worth noting that all types of federal and state landowner assistance are dependent on appropriations from legislative bodies. Figure 18 shows the perceptions of the effectiveness of industry assistance and the FSP by state agency foresters in the South.

Table 4-4. Coverage of the Forest Stewardship Program in the South.

| | New or Revised Plans Federal FY 2014 | | | Current Plans (As of 9/30/2014) | | Total Priority Lands* |
|----------|--------------------------------------|----------------------|-------|---------------------------------|-------------------------|------------------------------|
| | Acres | Priority Acres* | Plans | Acres | Priority Acres* | Acres |
| Alabama | 47,017 (19,027 Ha) | 13,290 (5,378 Ha) | 361 | 613,161 (248,138 Ha) | 142,770 (57,777 Ha) | 11,770,620 (4,763,405 Ha) |
| Arkansas | 38,903 (15,743 Ha) | 18,406 (7,449 Ha) | 216 | 841,650 (340,604 Ha) | 372,216 (150,631 Ha) | 9,480,043 (3,836,441 Ha) |

44 Environmental Quality Incentives Program (EQIP) is the largest and most widely utilized of the Farm Bill programs. Forestry practices eligible for funding include forest health treatments, tree planting and reforestation activities, and FMP development.

| | | | | | | |
|----------------|-------------------------|-------------------------|------|-----------------------------|-----------------------------|--------------------------------|
| Florida | 42,221 (17,086 Ha) | 30,169 (12,209 Ha) | 217 | 405,975 (164,292 Ha) | 282,559 (114,348 Ha) | 10,898,721 (4,410,560 Ha) |
| Georgia | 101,016 (40,880 Ha) | 32,810 (13,278 Ha) | 304 | 879,270 (355,828 Ha) | 422,386 (170,934 Ha) | 14,650,624 (5,928,902 Ha) |
| Kentucky | 58,977 (23,867 Ha) | 43,950 (17,786 Ha) | 491 | 907,071 (367,079 Ha) | 687,911 (278,388 Ha) | 17,705,485 (7,165,162 Ha) |
| Louisiana | 9,228 (3,734 Ha) | 6,787 (2,747 Ha) | 80 | 98,263 (39,766 Ha) | 54,568 (22,083 Ha) | 10,091,376 (4,083,839 Ha) |
| Mississippi | 151,868 (61,459 Ha) | 60,482 (24,476 Ha) | 918 | 762,557 (308,596 Ha) | 288,967 (116,941 Ha) | 9,573,271 (3,874,169 Ha) |
| North Carolina | 8,966 (3,628 Ha) | 2,250 (911 Ha) | 77 | 305,010 (123,433 Ha) | 184,968 (74,854 Ha) | 9,998,403 (4,046,214 Ha) |
| South Carolina | 40,415 (16,355 Ha) | 18,643 (7,545 Ha) | 123 | 362,786 (146,814 Ha) | 169,533 (68,608 Ha) | 6,677,640 (2702347 Ha) |
| Tennessee | 8,708 (3,524 Ha) | 3,065 (1,240 Ha) | 77 | 243,412 (98,505 Ha) | 113,709 (46,016 Ha) | 6,965,613 (2,818,886 Ha) |
| Texas | 63,908 (25,863 Ha) | 45,927 (18,586 Ha) | 473 | 631,745 (255,658 Ha) | 433,776 (175,543 Ha) | 20,917,720 (8,465,108 Ha) |
| Virginia | 45,698 (18,493 Ha) | 30,090 (12,177 Ha) | 234 | 567,519 (229,667 Ha) | 360,447 (145,868 Ha) | 11,248,172 (4,551,978 Ha) |
| TOTAL | 651,356 (249,661 Ha) | 326,035 (123,781 Ha) | 3692 | 6,847,580 (2,678,382 Ha) | 3,640,335 (1,421,990 Ha) | 147,139,506 (56,647,011 Ha) |

Data Source: USDA Forest Service, Stewardship Mapping and Accomplishment Reporting Tool * Priority Lands have been identified in Forest Action Plans by the state.

Likert Scale ratings: 1 = Very ineffective, 2 = Moderately ineffective, 3 = Moderately effective, 4 = Very effective

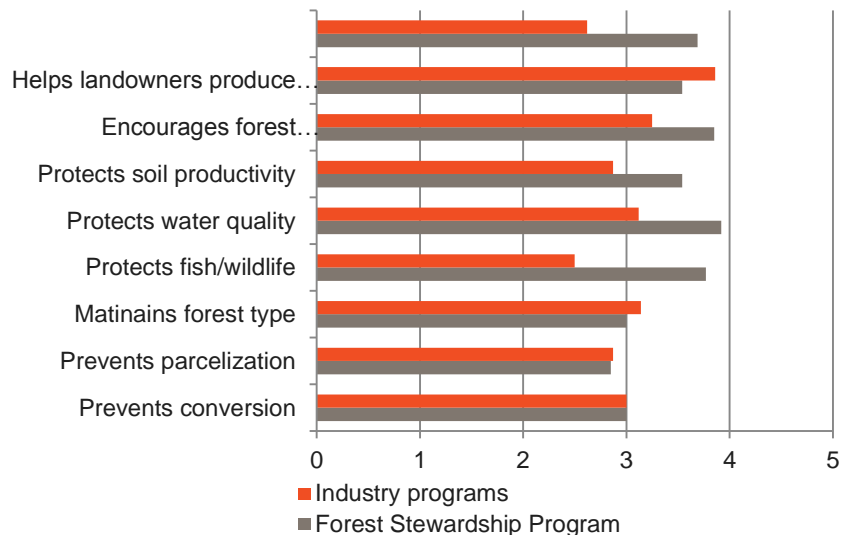


Figure 18. Perceptions of the effectiveness of industry assistance and the FSP by state agency foresters in the South. Source: Greene et al. 2007.

Forest Industry Assistance to Landowners

A variety of private industry programs provides incentives to landowners to undertake and/or implement forest management plans. On average, there are 20

programs available to landowners in each state. The forest industry has played a role in promoting the development of forest management plans too, in large part to establish business relationships with producers. Kaetzel (2011) found that NIPF owners in the South are more likely to seek and receive advice on managing their forest if it is a pine plantation as opposed to a natural hardwood forest, owing in part to the industry preference for softwood.

In part due to the economic recession of 2008, but also associated with other changes in the wood products industry occurring in the decade prior to this, recent years have seen decreased financial and technical assistance offered by industry (e.g., providing seedlings for reforestation on private lands). Forest product companies have assisted landowners within their supply areas by assisting in the development of forest management plans, either directly or through their participation and support of state Tree Farm committees of the American Tree Farm System, or more recently, Sustainable Forestry Initiative (SFI) State Implementation Committees.⁴⁵ There is little documentation available on the design, scale, scope, and effectiveness of these industry programs, as this assistance is part of a company's procurement or involvement in programs such as SFI Fiber Sourcing (see section 4.4).

A few additional ways in which the forest industry engages with private landowners include participating on state Forest Stewardship Program committees that assist state forest resource agencies with implementation of their Forest Stewardship Program, as well as providing seedlings to private landowners to assist with reforestation after timber is purchased from these landowners. This is predominantly practiced with planted pine. Likewise, eight of the 13 southern states (Virginia, North Carolina, South Carolina, Alabama, Mississippi, Tennessee, and Louisiana) have previously or currently maintain some type of cost-share assistance for private landowners with reforestation expenses.

In the US the wood and paper products industries have partnered with the American Tree Farm System (ATFS or Tree Farm) to provide substantial support for this NIPF owner focused certification system (see section 4.4), by providing volunteer foresters to develop management plans, complete Tree Farm inspections and help administer state Tree Farm programs.

Throughout the US, publicly supported technical and financial assistance have been closely associated with industry, for the purpose of assuring soil conservation, sustainability, and increased productivity within the forestry sector. Organizations involved in promoting and tracking the implementation of forest practices in any state may involve a combination of private forestry and operators associations, the state Tree Farm committee, the SFI implementation committee, and public agency organizations. Expertise and leadership is often shared among these organizations to whatever extent permitted by state laws (e.g. state rules governing the participation of government employees on NGO boards, and conversely, the participation of company representatives on leadership/advisory bodies for governmental institutions).

45 <http://minnesotaforests.com/informationcenter/privatelandowners/forestryassistance.aspx>

Such leadership in the state of Georgia is a good example. The Georgia Forestry Commission is a public agency responsible for providing leadership, service and education in the protection and conservation of Georgia's forest resources. Its board members include executives from the forest products industry, who are currently or previously have been members of the SFI state implementation committee and district chairs for the state Tree Farm committee.

Public and private cooperation promote that the forestry sector has enabled integrated delivery of programs, and shared accountability for any systemic issues that may exist. This solidarity within the forestry sector in the South—that includes landowner associations, the forest industry, and public forestry agencies—has served as a grassroots network for education and training, and partially accounts for the significant penetration of the SFI certification system and Tree Farm in the region.

This strong collaboration of industry, government and NIPFs has also has engendered resistance to changes in standards, including the introduction of stronger environmental standards that are difficult to push through the entire system. However, improvements are possible when there is strong case.

Biomass Harvesting Guidelines (BHG)

Best management practices specific to more intensive “all-fibre” removals have been adopted in several U.S. states, and are termed Biomass Harvesting Guidelines (Evans et al., 2013b). There are more BHG developed for northeast and north central states. In the Southeast, only the states of South Carolina and Kentucky have developed BHGs. The Stewards Forest Guild, a US-based forestry organization has developed BHGs addressing, among other issues, retention of dead wood in forest ecosystems of the South. In addition, the Southern Group of State Foresters developed a set of BHGs that have not been released publicly. To date all BHGs are voluntary and were developed in anticipation of more harvesting and intensive removals (removing more material from a site) for bioenergy. Since BMPs focus mainly on water quality, BHGs have a more significant focus on biodiversity and retention of legacy features within the stand. *Appendix C* is a state-by-state comparison of BMPs and BHGs using criteria and indicators adapted from the Montreal Criteria and Indicators for Sustainable Forestry as the framework for comparison.⁴⁶

The main focus of BHGs is the amount of down woody material (DWM) (i.e. coarse woody debris and fine woody debris) that can be sustainably removed without impairing forest productivity and habitat (Evans et al., 2013b; Fernholz, 2009). While the range of DWM retention targets varies in these guidelines—between 15 – 35% of potentially harvestable material—the amount that can be sustainably removed depends on the forest type, stand conditions, and site history. Guidelines therefore allow foresters and loggers to apply professional judgment for interpreting information in the guidelines. Some BHGs offer specific targets (e.g. leave one-

⁴⁶ <http://www.montrealprocess.org/>

third of limbs and tops on less fertile sites⁴⁷) and guidance related to intensive whole-tree harvesting techniques.

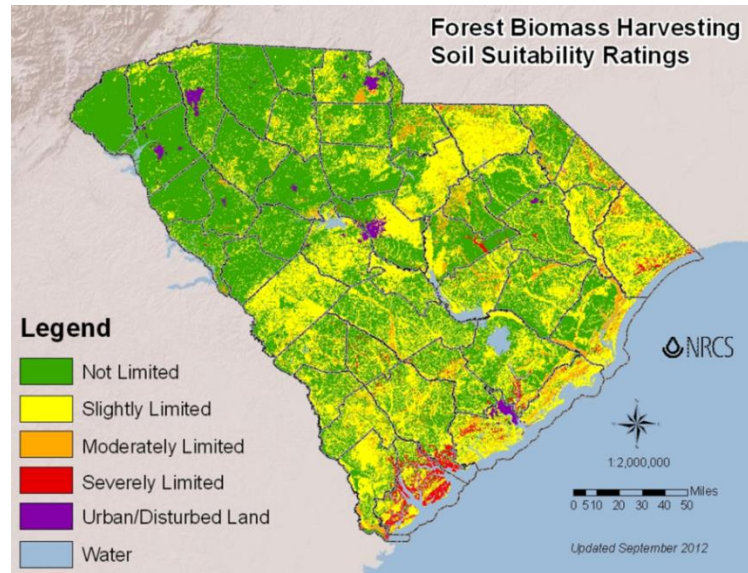


Figure 19. Forest soil suitability ratings as depicted in South Carolina’s BHGs. Source: South Carolina Forestry Commission.

BHG’s also identify instances when more intensive removals (stem, tops, limbs, etc.) pose the risk of long-term negative impacts, and promote adaptive management using criteria and indicators (C&I) of ecosystem integrity, although these C&I are not rigorously adhered to (Lattimore et al., 2009; Wintle & Lindenmayer, 2008). To date, most BHGs developed in the US include this adaptive approach (Evans et al., 2013; Fernholz, 2009). Some BHGs provide maps of sensitive and low-nutrient soils where they recommend retaining fine woody debris on harvest sites.

BHG’s address conservation of biodiversity by recommending increased retention of larger-diameter DWM, which numerous studies have shown are an important habitat and a food source for a number of invertebrates (e.g., arthropods, earthworms and beneficial microbes) and terrestrial vertebrates (e.g., small mammals, amphibians, reptiles, and birds) (Harmon et al. 1986; Evans, 2011). Standing dead snags provide nest sites for 20 – 40% of forest bird species, and studies have shown that they play an especially critical role as nesting and foraging sites for birds (Hagan & Grove, 1999). The size, abundance, location, stage of decay, and origin (e.g. natural mortality or killed through chemical or mechanical means) are all-important factors in how snags are utilized by wildlife (Jones et. al., 2009).

⁴⁷ Some guidelines also offer detailed descriptions to help identify nutrient poor sites.

While BHGs are science-based, the science is still inconclusive on amount and condition of DWM necessary to retain biodiversity and ecological function (NEFA, 2012; Evans et al. 2013b; Fernholz, 2009; Vance et al., 2014; Kittler & Beauvais 2010). Recent studies comparing intensive removals of logging residues with conventional harvests found little difference in estimated soil erosion rates, with the same of level of BMP implementation (Barrett, 2013). Standard practices have emerged for what can be considered responsible biomass harvesting and these are just now being adopted in the field (Evans et al., 2013b). Guidelines and the supporting science (Evans, 2011) is beginning to be used for third party certification.

While the costs and techniques associated with BMPs implementation are generally well understood, the implications of operationalizing BHG's are not, and many key constituencies, including loggers who would use them, are sceptical about BHG's (Fielding et al., 2012; Fielding, 2011). Surveys of landowners, foresters, and loggers in North Carolina revealed concerns that BHGs would add additional requirements, which along with existing BMPs and other rules, would make harvesting operations less feasible or less profitable. Of greatest concern are elements that cannot be calculated in the field⁴⁸, or developed without the consultation of foresters (Fielding et al., 2012). Another concern common to landowner associations, industry, and state forestry agencies, is the potential evolution of voluntary measures into regulatory measures.

4.4 Forest certification systems

Forest certification is a market-based system for providing independent verification and assurance that forest management meets accepted standards. Products originating from certified forests can be labelled as certified, provided that the chain of custody is ensured. Chain-of-custody (CoC) certification often includes requirements regarding not only the procedures that ensure the provenance of products originating from certified forests, but also additional requirements downstream (such as compliance with social and environmental standards in transport and processing) as well as conditions on the use of wood from non-certified forests entering the supply chain.

Forest management certification is well established within the solid wood products, paper, and packaging sectors in the Southeastern US. Combined with certified procurement, materials sold under a certification label of some kind accounts for a large but unreported volume of fibre trade in the Southeast. However, certified forests represent a much smaller share of total forest area partly because certified forests tend to be the larger tracts where timber management is a primary objective and the unit cost (\$/ha.) of certification is lower, and also because uncertified materials can after all still be included in labelled products. The difference between the volume of fibre derived from forestlands that have undergone forest management (FM) certification, and the larger volume of fibre included in products

⁴⁸ Instead of harvest retention targets survey respondents suggested doing periodic (5-year) monitoring of DWM on the forest floor.

that carry a certification label from a US based scheme, is important, and will be described in the section on procurement and labelling.

The advancement of forest certification in the U.S. has been driven by the need to demonstrate forest product sustainability. Research on the effectiveness of forest certification in the US has shown that certification improves forest planning, BMP compliance, biodiversity protection, monitoring, identification of sensitive species, reforestation, among many other benefits (Moore et al., 2012).

The three main forest certification programs of importance in the region are: the American Tree Farm System (ATFS), a program managed by the American Forest Foundation based in Washington, DC; the Forest Stewardship Council (FSC), an international certification system with a US standard and headquarters in Minneapolis, MN; and the Sustainable Forestry Initiative (SFI), headquartered in Washington, DC. Among the three ATFS is oldest as an organization, and largest considering the number of individual landowners counted as members, but not in area of land enrolled. The areas of forest covered by the three schemes in the region are illustrated in Figure 21.

PEFC (the Programme for the Endorsement of Forest Certification, an international forest certification system) has endorsed the FM certification standards of ATFS and SFI (for limitations on the endorsement for labelling, see below and Figure 22). There is no mutual recognition of FM standards between FSC and PEFC (and therefore FSC and SFI or ATFS) — which affects how FM certified fibre can be used to meet labelling requirements. Labelling and content requirements will be discussed following the section on FM standards and their differences.

Forest Management Certification

The FM certification standards for ATFS, FSC, and SFI are structured similarly, and reviews by many authors have detailed the differences in the scope of the standards and types of evidence used to show conformance. Only key differences in the systems—those pertaining to the environmental implications of sourcing pellets from the U.S. Southeast—will be described in this report.

Several studies have compared the standards of FSC and SFI, the two main forest certification systems in operation in the US (Cashore et al., 2007; Clark et al., 2011; Fischer et al., 2005; Overdest 2010, Price & Kavanaugh 2003, Sample et al., 2003). However, few studies have compared the field implementation of these standards and the effects on management (Mater et al., 2002; Sample et al., 2007). At present, there are no comparisons of the current versions of FSC-FM and SFI-FM standards currently in use. Virtually no comparisons include the ATFS-FM standard, which is significantly reduced in scope compared with SFI and FSC, being designed for small landholders. ATFS-FM requirements do not exceed SFI-FM or FSC requirements on any element, and lack many of the requirements that would be more cumbersome and expensive for smaller landowners (e.g. program of monitoring and science support, mapped designations of rare species occurrences other than those that are threatened or endangered).

Key Differences between ATFS, FSC and SFI Forest Management Certification

Overall, the three systems are built from similar overarching principles, with differences between these systems being expressed in the scope and specificity of the requirements. There are some important differences in the SFM certification standards that are potentially relevant to pellet exports:

- › ATFS, FSC and SFI require forest management operations to meet or exceed federal and state guidance on the protection of water bodies (BMP's).
- › FSC has a greater focus on biodiversity conservation. One key difference is the level of attention FSC places on species conservation and ecological issues. All systems address T&E species as required by Federal and state law, but FSC's standard requires more extensive protection of state and globally imperilled species (i.e. G1, G2, G3 and S1, S2 species) as opposed to SFI (G1 & G2).⁴⁹ Under both systems auditors evaluate whether forest managers address relevant species data sources and whether provisions are made to protect species occurring on their land—though for a different suite of species and communities.
- › The size of allowable openings and clear-cuts varies between the FSC and SFI Standards, and is absent from the ATFS standard. FSC's upper limits for the US are still smaller nationally (i.e. a 40-acre average, 80-acre maximum) although larger openings are allowed under certain instances in the South,⁵⁰ whereas SFI's limit on the average is 120 acres. As there are few limitations on the size of clear-cuts in state or federal policies governing the region from whence pellets are exported, the limits imposed by certification standards are potentially important for maintenance of natural regeneration of forest types, and habitat distribution in intensively managed landscapes.
- › The FSC and SFI approach forest type conversion differently in both their SFM and their procurement systems, and there is no limitation on use or type conversion in the ATFS standard. FSC has a more restrictive standard on the conversion of natural forests to plantations⁵¹ and is focused at the forest management unit (FMU)-level (i.e. conversions after 1994 cannot be certified). SFI focuses at the "landscape level" in the sense that certificate holders can

⁴⁹ "Conservation status ranks" were developed and are maintained by NaturServe and rate the relative vulnerability of species at the Global (G) and state/province (S) scales. In the U.S. rankings at the state scale mean that the species rank is based on relative rarity or imperilment in individual states, but not at the global scale. Rankings are provided on a 1 to 5 scale, with 1 to 3 indicating some level of vulnerability: (1) Critically Imperiled: At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors. (2) Imperiled: At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors. (3) Vulnerable: At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. <http://explorer.natureserve.org/ranking.htm>

⁵⁰ The FSC US standard accommodates larger clearcuts in the US Southeast regional even-aged management indicators (see FSC southern regional indicator 6.3.g.1). This indicator refers to FSC Principle 10 but also uses the term "should," which means that the clearcut restrictions can vary if a justifiable reason exists.

⁵¹ "Natural or semi-natural forests that are changed to plantations per the FSC definition are considered conversion. There is no practical way to distinguish FSC Plantations from natural or semi-natural forests using readily available datasets, however. There is some information regarding planted stands in the Southern Forest Resource Assessment (SFRA), but planting alone does not distinguish Plantations as defined in the FSC system." (FSC NRA, 2015)

convert forest types so long as no unique values being lost at the landscape-level (allowing conversion as long as the rare forest types remain present elsewhere),, i.e. considering other ownerships and relating conversion to protection of certain species and communities (G1 and G2 species) that likely are already protected under the ESA.⁵² FSC evaluates risks of type conversion on a case-by-case basis through the FSC standard and during audits, restricting forest type conversion due to concerns of impacts to biodiversity. ATFS does not have prescriptive requirements on protections for imperilled species or ecological communities aside from those designed as threatened or endangered. ATFS-FM does include guidance for identification of forests of recognized importance (FORI) that represent "...globally, regionally, and nationally significant large landscape areas of exceptional ecological, social, cultural, or biological values", and does not include prescriptive requirement to protect them.

- › All systems allow for the certification of pine plantations although FSC places additional restrictions on the intensity of management (i.e. does not certify plantations converted after 1994, places greater restrictions on forest chemical use, bedding, rotation length, species composition). Additionally, FSC includes more requirements addressing age-class diversity at the FMU-level, to assure that certificate holders are achieving a balanced or justifiable distribution of age classes and forest types.
- › Late successional old-growth (LSOG), is not mentioned by the ATFS standard, and addressed differently by FSC and SFI. FSC requires old-growth protection at the FMU level, and prohibits clearcutting of forest stands greater than 100 years of age in the Southeastern region. Similar to its approach on forest type conversion, SFI requires the promotion of conservation of LSOG only at the landscape level (i.e. including other ownerships), allowing the harvest of such forests as long as it is considered adequately protected elsewhere. However, it promotes support for research/education.

Requirements for Chain of Custody and Labelling Product as Certified

Processors using primary wood fibre or secondary wood products, and retailers seeking to sell raw materials or finished products that can be labelled as FSC, PEFC, or SFI certified, must secure chain of custody (COC) certification of the respective system. COC systems require that parties involved in transfer and trade have instituted controls to distinguish, sort, and account for the volume materials that are certified content, recycled, and from other sources. FSC, PEFC, and SFI have each developed rolling average, batch-crediting, and other methods that enable claims (or meet thresholds) on the certified content of constituent materials. ATFS does not have a chain of custody standard or label used in the marketplace.

These methods, in combination with comprehensive tracking and documentation requirements, are not only designed to assure provenance and percentage of

⁵² Note that US environmental and forestry laws do not use HCV or SFI's Forests of Exceptional Conservation Value (FECV).

certified content, but also to control sourcing risks for non-certified content. The different systems have different rules on labelling/trade based on the origin of materials that intermingle certified forest content in the product stream.

The systems for tracking the *certified content* are similar among the systems, and do not warrant comparison. For the purpose of evaluating the environmental impacts of production and trade of wood pellets, the differences in rules for using non-certified content are more important, and potentially significant to purchasers seeking to control risks.

Regarding the mixing of fibre of non-certified origin, FSC uses a “Controlled Wood” (CW) standard (described more below) for uncertified sources, which can be mixed with certified content for labelled products, but may not constitute more than 30% of volume. Facilities with COC certification must apply the CW standard to all sourcing, whether or not used in FSC claims.

PEFC also requires that goods carrying its label include at least 70% certified content (thus no more than 30% can come from uncertified forest). As SFI is recognised by PEFC, this requirement also applies to SFI if products are to be labelled as PEFC-certified.

However, SFI also uses another label, the “Certified Sourcing” label, based on the SFI Fiber Sourcing Standard (SFI-FS). This standard (and label) is not endorsed by PEFC. The “Certified Sourcing” label is unique in comparison with PEFC and FSC accepted labelling schemes in that it allows for the labelling of fibre derived entirely from forests that are not certified to forest management standards. The majority of fibre marketed as “certified” in the US market comes from this label.

The relations of the three schemes and labels are illustrated in Figure 22. The requirements of SFI and FSC regarding wood coming from non-certified sources are discussed below in more detail. As SFI fibre is mostly marketed under its own label, rather than PEFC’s, the requirements specific to PEFC are not discussed in detail.

Sustainable Forestry Initiative

For uncertified sources SFI uses a “non-controversial” source policy however, it functionally applies only to procurement from outside the US and Canada. For domestic sourcing, any wood fibre can be included in labelled products at up to one-third by weight or manufacturing unit, within certified sourcing (i.e. uncertified fibre), recycled materials, and certified. The remaining two-thirds could be certified wood (SFI-FM or ATFS), recycled, and uncertified fibre that conforms SFI Fiber Sourcing standard (described below).

The SFI Chain of Custody standards include definitions of different fibre sources, tracking requirements, and volume accounting rules for use with the SFI certification labels. There are several types of fibre sources that must be tracked by volume (fibre-sourcing, certified forest content, pre-consumer recycled content, post-consumer recycled content, and non-controversial sources.) There are two principles types of labels. The Chain of Custody Label, which requires 70%

certified content (and recognised by PEFC, as discussed above. SFI's other label is a Certified Sourcing label, based on the SFI Fiber Sourcing Standard (SFI-FS).

SFI-FS is designed to assure that wood is not from controversial sources (of which there are none currently pre-defined in the U.S. Southeast, but for which a company may undertake a risk assessment). SFI-FS also includes a program of outreach on BMP's, wildlife, sensitive species, and logger training and safety.

SFI developed its Fibre-Sourcing program as a way to integrate non-certified and certified (SFI-FM and ATFS-FM) content, presumably in response to the lack of availability of sufficient certified wood that would allow on-product labelling according to PEFC standards. The SFI Fibre-Sourcing standard⁵³ requires companies to develop a sourcing plan that helps ensure that all applicable laws are complied with throughout their supply chain by educating and training actors within the supply chain. The standard also requires companies to develop and share information with their suppliers on the requirements for operator training, BMP's, and potential occurrences of rare species. The emphasis is on training and education, and that operators have completed "master logger" training programs offered by the industry and state agencies. There is no requirement for forest certification or other forest-level verification of the fibre supplied to a facility—as evidence of conformance can be based on state-level reporting of BMP implementation. The industry has invested substantially in operator training, to improve the standard of practice throughout the supply chain.

SFI Fibre Sourcing is presently a large component of the trade in certified wood volume from the Southeastern US, especially paper and packaging bearing the SFI label. The SFI "Certified Sourcing" appears more prevalent in the marketplace compared with SFI's mixed-sourcing label that requires percentage based claims and which is recognised by PEFC: (i.e. % certified FM, % recycled, % FS), however this data is presently unavailable.

Public summaries of SFI certification and surveillance audits provide some insight into how the fibre-sourcing system works in practice. Among ten fibre-sourcing audit summaries for operations located in the Southeast, a range in sophistication and conformance approaches was evident.⁵⁴ Among the reviewed reports included

⁵³ <http://www.sfiprogram.org/sfi-standard/fiber-sourcing-standard/>

⁵⁴ Bureau Veritas Certification North America Inc. SFI Audit Report. 2014. International Paper Company (BVC - US.1556137). <http://www.sfiprogram.org/audit-reports/international-paper-company-november-2014/>

Bureau Veritas Certification North America Inc. SFI Audit Report. 2014. Procure LLC.

<http://www.sfiprogram.org/audit-reports/procure-llc-february-2014/>

Bureau Veritas Certification North America Inc. SFI Chain of Custody Audit Report. 2014. Georgia Biomass, LLC. <http://www.sfiprogram.org/audit-reports/georgia-biomass-llc-july-2014/>

Bureau Veritas Certification North America Inc. SFI Fiber Sourcing Audit Report. 2014. Enviva, LP.

<http://www.sfiprogram.org/audit-reports/enviva-lp-march-2014/>

Bureau Veritas Certification North America Inc. SFI Forest Management Audit Report. 2015.

Catchmark Timber Trust. <http://www.sfiprogram.org/audit-reports/catchmark-timber-trust-inc-april-2015/>

NSF. 2012 Green Circle Bio Energy Inc. SFI Public Summary Recertification Audit Report. 2012.

<http://www.sfiprogram.org/audit-reports/green-circle-bio-energy-april-2012/>

NSF. 2014. SFI Public Audit Report Glatfelter Chillicothe Woodlands. 2014.

<http://www.sfiprogram.org/audit-reports/glatfelter-chillicothe-woodlands-november-2014/>

companies that also had SFI certified forest management certificates, companies without land that sourced wood for processing (including three bioenergy companies), and another two companies that neither managed lands nor produced wood products (i.e. brokers).

The way in which different entities meet the fibre-sourcing standard appears to vary. Many relied entirely on state reporting of BMP compliance, and materials developed by outside parties (state agencies, Tree Farm, and the SFI state implementation committees) for understanding whether their sources may be violating BMPs, and for providing suppliers with information on proper operations and species protections. This information addresses state-wide implementation and training rates for all producers and operators in a state. In other words a facility relying entirely on state data, relies on reported compliance with BMPs (which in recent reporting suggests very high levels of implementation), and assumes that this information applies to their suppliers. Certificate holders that are integrated operations supplementing their own material with sourced material appear to have better due diligence systems in place. One wood dealer reviewed appeared to have little source-control and engagement. Two companies using wood for bioenergy were advised (as an “opportunity for improvement” identified in audit reports) to improve due diligence on stand-level habitat elements affected by operations, and expand knowledge on regional conservation priorities. Neither instance was considered a non-conformance with the Fiber Sourcing standard.

Another finding points to the variability in state programs, in this instance relating to South Carolina, which did not have a logger certification program at the time of the audit. In the same report, it appeared that the auditor made the determination that forested wetland operations were not subject to state BMPs (i.e. which applied to riparian zones).

An important conclusion to be drawn from this review of a few audit report summaries is that risks associated with certified procurement can vary by setting, and type of entity, as this certification relies on systems in place, beyond its control. A more conclusive assessment of environmental risks associated with this system would require access to full audit reports held by companies.

Forest Stewardship Council

The FSC Chain of Custody standard includes detailed tracking, documentation, and accounting procedures for use of FSC on-product labels or provision of content claims to downstream manufacturers. FSC has three labels: “100%”, “Mix”, and “Recycled.”

NSF. SFI Certification Audit Final Report Summary. 2015. Drax Biomass International, Inc. <http://www.sfiprogram.org/audit-reports/drax-biomass-inc/>.
 NSF. Sonoco Forest Products Company . SFI Summary Recertification Audit Report. June, 2012. <http://www.sfiprogram.org/audit-reports/sonoco-products-company-june-2012/>.
 NSF. Surveillance Audit Report – Sustainable Forestry Initiative Standard. April 2, 2014. Sonoco Products Company. <http://www.sfiprogram.org/audit-reports/sonoco-products-company-april-2014/>.

The COC standard allows fibre from uncertified forests to enter COC-certified operations, requiring that this portion either be excluded from FSC-labelled materials, or included in the “Mix” label, not to exceed 30%. FSC COC-certified facilities must adhere to the Controlled Wood requirements for all fibre in the supply chain whether or not the label is used on finished products. CW is designed to reduce the environmental risks of sourcing materials traded under the FSC label as a result of the batch-crediting system. It is not considered certified content.

CW relies on the identification of “districts with unspecified risks” and involves a risk assessment process. Companies must carry out a the assessment for their procurement, and should the audit reveal any of five issues to be an unspecified risk (i.e. not easily proven to be a “low risk” as FSC does not use the term “high-risk,”) the company is required to individually evaluate that particular risk in their supply area and develop mechanisms to control the risk as specified.

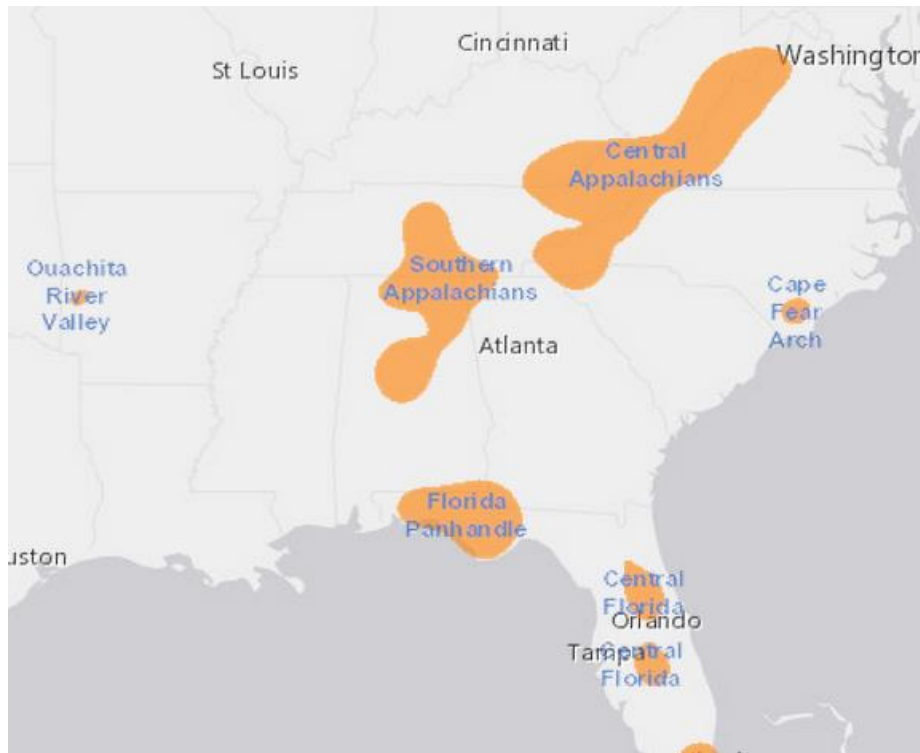


Figure 20. Areas considered to be HCV 1: critical biodiversity areas under FSC’s Draft National Risk Assessment. Note that longleaf pine stands and forested wetlands over 80 years old are also considered to be HCV 1 areas under the draft national risk assessment. Source: FSC Controlled Wood National Risk Assessment.

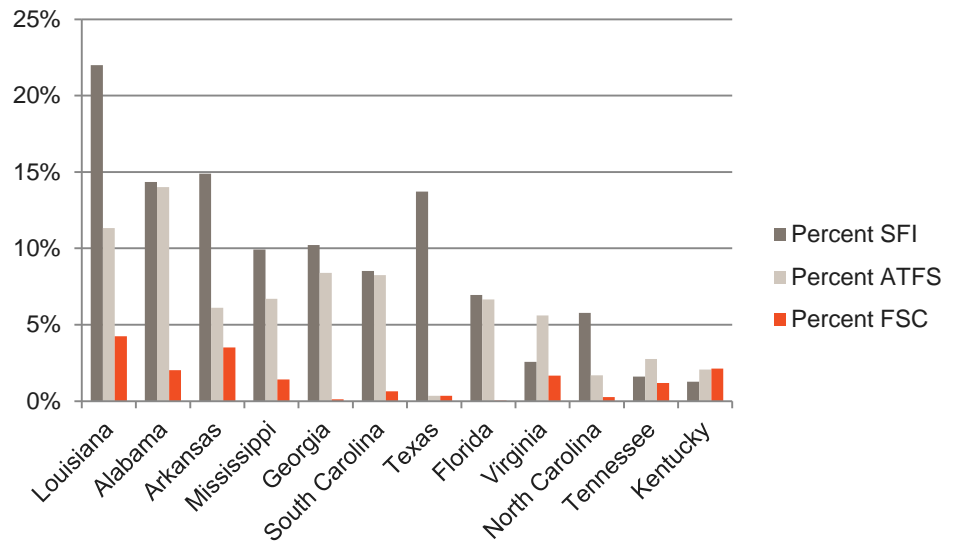


Figure 21. Percent of Total Forestland in Southern States Certified by FSC, SFI, ATFS. Source: Lowe et al. (2011); FSC US.

The process of risk assessment by each company for their own supply area has proven expensive and prone to inconsistencies, so FSC has performed a risk assessment for the US (as part of a country-by-country risk assessment) that will apply to the wood pellet market.

FSC’s draft national risk assessment for the US identified potential High Conservation Value (HCV) including the high concentrations of biodiversity and vulnerable species and ecological communities that are significant at global, regional, or national levels. Pellet mills using the FSC standard in the US will soon be required to use the FSC national risk-assessment for the US, which identifies high conservation value areas (see Figure 20) and descriptive information about other risks (e.g. longleaf pine and forested wetlands of 80-years or older).

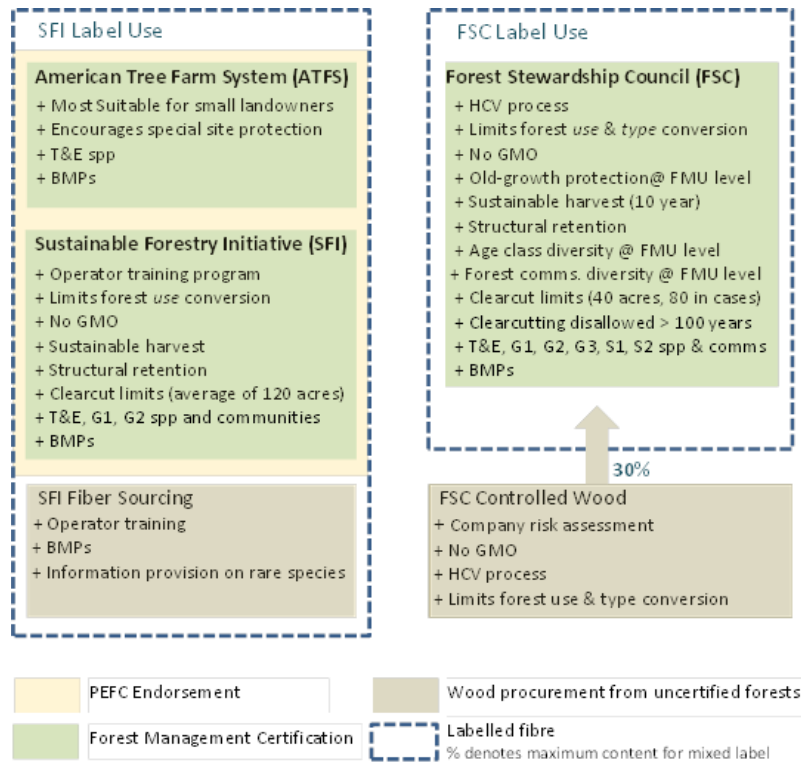


Figure 22. Summary of relationship between ATFS, FSC, and SFI systems’ labelling and FM certification standards. Key attributes of the FM standards, related to environmental implications discussed in this report are listed under each certification scheme.

Use of Certification by Existing Pellet Producers

A considerable challenge exists in that only 17% of Southeastern forests are presently certified. This is mostly on industrial lands certified to the SFI forest management standard. Most NIPF landowners know little about certification (Morris, 2014). In the Southeast, the Sustainable Forestry Initiative (SFI) and the American Tree Farm System (ATFS) have the largest coverage. While FSC has historically had low penetration in the South, there is evidence that this is beginning to change as acres under FSC have increased since 2011. Additionally, some large forest product companies have made public commitments about using FSC.

Table 4-5. Land under forest management certification in the US South.

| | Total Forestland (acres) | Acres SFI | Acres ATFS | Acres FSC |
|----------|-------------------------------|-----------------------------------------|-----------------------------------------|---------------------------------|
| Alabama | 22,692,817 (9,183,465 ha) | 3,255,868 / 14.35% (1,317,604 ha) | 3,181,418 / 14.02% (1,287,475 ha) | 461,069 / 2.03% (186,588 ha) |
| Arkansas | 18,829,891 (7,620,193 ha) | 2,805,293/ 14.90% (1,135,263 ha) | 1,150,676 / 6.11% (465,662 ha) | 660,184 / 3.51% (267,167 ha) |
| Florida | 16,146,905 (6,534,426 ha) | 1,121,313 / 6.94% (453,780 ha) | 107,6054 / 6.66% (435,464 ha) | 5,000 / 0.03% (2,023 ha) |
| Georgia | 24,783,744 (10,029,634 ha) | 2,532,586 / 10.22% (1,024,902 ha) | 2,083,638 / 8.41% (843,219 ha) | 31,757 / 0.13% (12,852 ha) |
| Kentucky | 11,970,446 | 152,000 / 1.27% | 247,785 / 2.07% | 254,550 / 2.13% |

| | | | | |
|----------------|--------------------------------|---------------------------------------|---------------------------------------|---------------------------------|
| | (4,844,272 ha) | (61,512 ha) | (100,275 ha) | (103,013 ha) |
| Louisiana | 14,221,733 (5,755,336 ha) | 3,129,004 / 22% (1,266,264 ha) | 1,610,198 / 11.32% (651,625 ha) | 603,584 / 4.24% (244,262 ha) |
| Mississippi | 19,622,417 (7,940,917 ha) | 1,946,526 /9.92% (787,732 ha) | 1,313,304 / 6.69% (531,476 ha) | 280,349 / 1.43% (113,453 ha) |
| North Carolina | 18,446,595 (7,465,079 ha) | 1,065,980 / 5.78% (431,387 ha) | 311,627 / 1.69% (126,111 ha) | 47,389 / 0.26% (19,178 ha) |
| South Carolina | 12,745,895 (5,158,085 ha) | 1,086,784 / 8.53% (439,806 ha) | 1,050,359 / 8.24% (425,066 ha) | 80,875 / 0.63% (32,729 ha) |
| Tennessee | 14,480,278 (5,859,966 ha) | 231,868 / 1.6% (93,834 ha) | 398,919 / 2.75% (161,437 ha) | 172,536 / 1.19% (69,823 ha) |
| Texas | 17,273,287 (6,990,257 ha) | 2,368,824 / 13.71% (958,630 ha) | 59,161 / 0.34% (23,942 ha) | 60,224 / 0.35% (24,372 ha) |
| Virginia | 15,765,707 (6,380,161 ha) | 406,552 / 2.58% (164,526 ha) | 884,416 / 5.61% (357,911 ha) | 264,009 / 1.67% (106,841 ha) |
| Total | 206,979,715 (83,761,791 ha) | 19,950,750 (8,135,240 ha) | 13,367,555 (5,409,663 ha) | 2,921,526 (1,182,301 ha) |

Cost of Certification

The cost of certification is frequently cited as a barrier to greater adoption of certification in the US Southeast. The industrial wood pellet production cost-structure is different from that of other pulpwood purchasers. Pellet manufacturers are typically willing to pay less for feedstocks, giving rise to questions about the economic feasibility of certification. There is no simple cost determination as the preferred sourcing model will be different from place to place. However, twenty years' worth of experience within other wood using industries has provided data on unit costs for forest management certification.

The expenses associated with forest management certification are incurred through preparation for the initial gap assessment, inspections, remedial actions, follow up inspections, ongoing management improvements, record keeping, etc. For instance, in North Carolina, Duke University (3,237 hectares), North Carolina State University (1,844 hectares), the North Carolina Department of Forest Resources (17,213 hectares) all decided to dual certify their forests to the SFI and FSC forest management standards, the cost of certification across this total 22,336 hectares in terms of direct costs was ~\$70,000 for FSC (~\$0.53/hectare) and ~\$36,000 for SFI (~\$0.29/hectare) (Cubbage, et al. 2002). Conversely, the Southern Group of State Foresters recently stated that annualized per-hectare costs for ownerships less than 10,000 acres is \$6.14 for SFI and \$1.23 for FSC (Lowe et al., 2011).

Who pays certification expenses is likely an important factor in whether or not landowners consider adopting such measures. If the wood purchaser offers a premium for harvested wood then it stands to reason that more landowners will consider becoming certified. Another option could be for wood purchasers to pay for certification expenses.

Forest Certification of Small Landowners

Given the extensive amount of wood harvested from small landholdings across the South this is an especially relevant topic for this study. Morris (2014) found few NIPF landowners in North Carolina with existing knowledge or interest in forest certification programs, which is consistent with trends observed nationwide (Kilgore et al., 2007). Common reasons for a lack of interest in certification by NIPF owners include: (1) lack of desire to be publicly recognized for stewardship activities, (2) lack of financial benefits relative to the cost of certification, (3) perception that certification could limit flexibility in forest management approaches, and (4) belief that certification will lead to greater exposure to regulation and future government scrutiny.

Other landowners who have participated in cost-share programs to develop forest management plans may be more willing to consider certification (Esseks & Moulton, 2000) particularly if presented with an economic incentive (e.g. a price premium or financial assistance). For instance, landowners supplying a Gainesville, Florida bioenergy facility are given a \$0.50/ green ton price premium for biomass from lands enrolled in the Forest Stewardship Program or a \$1.00/green ton premium for biomass coming from FSC-certified forest (Larson et al., 2012). On a per hectare bases, Kilgore et al. (2007) estimated that at least \$9.84/hectare⁵⁵ would be needed to enrol at least 50% of landowners in a Minnesota forest certification effort, a Northern state generally considered to have considerably greater cultural tolerance for regulatory approaches than the South.

The American Tree Farm (ATFS) program discussed above was developed in 1948 as a voluntary membership program to help woodlot owners develop and implement forest management plans. It did not initially include third-party inspections, but rather enrolment was typically handled by the forester who developed the plan (public service forester or consultant) in cooperation with the landowner. The landowner signed a commitment that was embodied in the plan that was developed. This inherently grassroots, learning and commitment-based program has had great success and has shown to align well with landowner interests. The inspection and auditing regime became more formal with the recognition by SFI and subsequently, endorsement by PEFC. Through the association with SFI, a review of ATFS certified lands is most likely to occur through audits for SFI-COC certification. Together, ATFS and SFI comprise around 87% of all certified forests in the US, with 53% of ATFS lands existing in the South. However, the amount of ATFS certified land is still only about 10% of all NIPF lands in the South (Figure 21).

To date NIPF owners in the South have rarely participated in FSC. However, there is an FSC group certification option whereby an FSC certified forester can work with several NIPF owners to develop FSC compliant forest management plans for certification. Across the South, there are a handful of FSC group certificates (see Table 4-6).

⁵⁵ Note that this analysis did not factor “market access” into the \$24/acre estimate.

Table 4-6. FSC Group certificates in the South. Source: FSC US

| FSC group certificate holder | State | Acres |
|-------------------------------------------|----------------|-----------------------|
| Alabama Treasure Forest Association | AL | 67,707 (27,400 Ha) |
| Blue Ox Forestry | AL | 4,794 (1,940 Ha) |
| Buchanan Timber and Forestry | AL | 19,094 (7,727 Ha) |
| Center for Forest and Wood Certification | KY, VA, TN | 5,535 (2,240 Ha) |
| Four States Timberland Owners Association | AR, TX, OK, LA | 97,653 (39,519 Ha) |
| GreenLink Forest Resources, LLC | SC | 17,740 (7,179 Ha) |
| Jasper Lumber Management group | AL, MS | 4,861 (1,967 Ha) |
| Mid Carolina Timber Company, Inc. | SC | 4,440 (1,797 Ha) |

Operator-Based Certification Programs

In Tennessee Master Logger certification makes newly certified loggers liable for all applicable water quality laws for the year after initial certification. In Kentucky every commercial timber harvest must have a certified master logger onsite at all times, note that a small amount these harvest operations are also subject to point of harvest verification through the Rain Forest Alliance’s Smart Logger program offered by the University of Kentucky (see discussion below). Kentucky has reciprocal master logger agreements with Virginia and Tennessee meaning that loggers certified by those states are considered certified master loggers in Kentucky and vice versa. Virginia’s SHARP⁵⁶ logger program include most of the loggers operating in the state.

The Rain Forest Alliance’s Smart Logger program⁵⁷ (mentioned above) is a “point of harvest certification programs.” Participating loggers agree to follow a standard against which their performance is audited annually by having a third party evaluate a sample of their logging jobs each year. This approach was pioneered in 2003 by loggers who began the Trust to Conserve Northeast Forestlands and is practiced widely in the New England States. In the south, there are 40 companies (small to midsize logging operators) that are Smart Logging certificate holders (3 in Louisiana, 11 in Kentucky, 26 in Tennessee). As explored in appendix C some states are operating spot check verifications and maintain master logger programs. Therefore, in a sense some of these programs have the bits and pieces of the Smart Logger..

⁵⁶ <http://sharplogger.vt.edu/>

⁵⁷ <http://www.rainforest-alliance.org/forestry/certification/smart-logging>

Some states operate programs to help landowners get their property certified. These tend to align with the ATFS program but there are some examples where FSC certification also applies. For instance, the Alabama Treasure Forest Program⁵⁸ is an FSC group certification, which has helped enrol over 27,459 hectares. Similarly, the state of Wisconsin in the North Central region of the US boasts what is arguably the most successful state-led program as judged by the number of hectares (over 980,000 Ha) and landowners engaged.⁵⁹

4.5 Bioenergy Certifications Systems

In recent years, emerging European sustainability criteria and public concerns have driven the creation of certification systems specifically for the bioenergy industry. Several of these programs are reviewed in depth in other reports (Sikkema et al., 2014; Kittler et al., 2012; Fritsche et al., 2014).

This section focuses on a bioenergy certification system emerging from the wood pellet buyers in Europe, which is being designed largely for application by industrial pellet export facilities in the US South, so an examination of this system is of particular relevance for this report.

Sustainable Biomass Partnership

The Sustainable Biomass Partnership (SBP)⁶⁰ is an industry-led initiative formed in 2013 supported by seven European utilities sourcing wood pellets from North America. The stated intent of the SBP is to help these utilities, and by extension their wood pellet suppliers, meet existing country-level sustainability criteria of the Netherlands (NL) and the United Kingdom (UK), and forthcoming criteria of Belgium (BE) and Denmark (DK). The SBP is developing, testing, and refining a uniform biomass procurement standard for wood pellet mills to use and methodologies for third-party verification of compliance to these standards.

There are several factors driving this industry led effort related to the subsidy programs offered by the UK and the Netherlands, and the sustainability criteria to which these incentives are linked. Both countries have a preference for wood pellets that originate from certified forests, with the Netherlands requiring a minimum percentage of wood pellets be FSC forest management certification “or equivalent”⁶¹ and that a risk-based approach be undertaken to cover segments of the supply chain not presently FSC certified.

The UK requires that their national timber procurement policies apply for pellets. This system offers two pathways to compliance, category A and category B. Category A is a straightforward default to sourcing with forest management certification, with wood needing to include at least 70% certified by FSC or a PEFC

⁵⁸ <http://alfafarmers.org/stories/news-detail/treasure-forest-certification-makes-the-most-of-forestland#.VVLJF15Vikr>

⁵⁹ <http://dnr.wi.gov/files/pdf/pubs/fr/FR0295.pdf>

⁶⁰ <http://www.sustainablebiomasspartnership.org/>

⁶¹ At this writing, “or equivalent” is not defined.

endorsed system (i.e. “sustainable”), with the remaining 30% of “un-certified” content from “legal sources” in order to demonstrate that supplies are both “legal and sustainable,” a requirement of UK policy. While not requiring certification, Category B⁶² calls for “equivalent evidence” as Category A, (i.e. at least 70% determined by CPET as being from “sustainable” origins, with 100% “legal”).

The SBP framework also aims to develop a standardized process for gathering data to calculate energy and carbon balances in biomass pellet production, transport, and energy conversion. It is made difficult by the lack of standardised requirements for products to meet, as well as the considerable heterogeneity of the evidence base that SBP relies on regarding the source of wood being procured by the facilities they certify.⁶³ Existing forest certification systems do not presently incorporate such assessments, and many stakeholders involved with forestry in the US, including many government representatives at the state and federal level, are opposed to approaches that involve emissions tracking at the facility level—favouring regional assessments based on net flux (see section on emissions).

Version 1.0 of the SBP framework was introduced in March 2015 and SBP has a goal of finalizing version 2.0 in 2016. Structurally the SBP addresses three segments of the supply chain: (1) identifying risks in the pellet mills’ sourcing strategy, (2) collecting data on the source of feedstocks, production, and (3) calculating supply chain energy and carbon balance.

By design, SBP intends to rely on processes already in practice -- including the acceptance of other standards for fibre sources and reliance on certification bodies and accreditation processes already in existence. SBP’s standards also reference methods and resources developed by other certification schemes, as guidance for conformance with the SBP standard. For example, to meet the requirement for stakeholder consultation verifiers are recommended to refer to FSC’s verification procedures.

The stated intent of the SBP standard is that in order for a BP to make the claim that biomass products are compliant with the SBP systems, materials must be produced using feedstocks that are: (1) received from sources with an SBP-approved claim (i.e. approved forest management, CoC, controlled feedstock); (2) procured from a defined Supply Base (SB) in a manner conforming with the SBP standard; or, (3) derived from tertiary (recycled) sources. Presently, several forest management and CoC certificates will be accepted as an approved claim for

⁶² UK Timber Procurement Category B Requirements: (1) Third-party verification of items 2, 3 and 4 below, (2) Demonstrate Chain-of-Custody/traceability in the supply chain to the forest source for 70% of material, where 70% must be legal and sustainable, with balance being legal), (3) demonstrate the harvested fiber complies with applicable laws, (4) Demonstrate the site-specific sustainability of the source of 70% of harvested fiber, including third-party verification of this sustainability, (4) A locally applicable definition of sustainability is required, (5) Specific requirements for how the definition was developed (multi-stakeholder process etc.), (6) Overall forest management principles and criteria to: (a) Minimize harm to ecosystems, (b) Maintain forest productivity, (c) Ensure forest ecosystem health and vitality, (d) Maintain biodiversity, and (e) Include social criteria

⁶³ Note that currently the greenhouse gas balance requirements of European sustainability criteria do not place direct responsibility on pellet producers, energy generators, or other supply chain actors to account for the temporal change in forest carbon stocks either at the level of facility supply areas—i.e. the pellet mill catchment area to use SBP terminology—or at the level of sourcing regions. This is an area of intense debate both within the scientific and broad stakeholder communities (Pinchot Institute, 2013).

sources derived from outside the supply base. These include forest management and/or CoC certificates for FSC, PEFC, SFI, and GGL. SFI-FS, or the Certified Sourcing label, has not been approved as an acceptable source.

As the SBP standard is relatively new, it has not been assessed through independent studies and as its version 2.0 is expected to be released in the near future, it is not assessed in more detail here. However, five companies in the Southeast that have been through audits to the SBP standards. They include:

Lee Energy Solutions (Crossville, Alabama) – *Summary report not available*

Georgia Biomass, LLC (Waycross, Georgia)

- Total Supply Base area: ~5.3 million ha
- Total volume of feedstock: ~1.4 million tonnes

Solvay Biomass Energy, LLC, (Houston, Texas) – *Summary report not available*

Varn Wood Products (Hoboken, Georgia) – *Summary report not available*

Westervelt Renewable Energy (Tuscaloosa, Alabama)

- Total Supply Base area: ~ 17.3 million ha (i.e. the states of MS and AL)
- Total volume of feedstock – 400,000 to 600,000 tonnes

Among the five that have, according to the SBP website received certificates, there are two public summary reports that have been made available, for Georgia Biomass and Westervelt. Another, Enviva, is now in the public consultation phase and has released their draft supply-base evaluation (SBE) for their Wilmington, NC fibre sourcing area as part of this process.

5 Production of biomass for energy

5.1 Biomass supply Chain

Context of the biomass supply chain

Contextually, wood product supply chains are quasi-linear industrial processes through which feedstock is procured, modified in milling infrastructure, and converted to commercial products and non-product waste streams. A simplified industrial process is detailed in Figure 23⁶⁴.

Environmental risks are present in different ways at each step in the process depicted. At the beginning, a landowner may or may not consult a forester and other natural resource professionals and/or information sources for advice prior to timber harvest. Risk is also present in the quality of services provided and/or qualifications of those providing it (training, licensing, and certifications). A forest management plan may or may not be present and it may or may not be certified. Moreover, the involvement of natural resource professionals at various points in the supply chain is more accurately thought of as possibly modulating environmental risks and not eliminating them outright.

The second step in the process typically involves two alternative streams: stem logging (whereby the bole of the tree is delimited in the forest or at the roadside and only the Roundwood is removed) or whole-tree in-woods chipping (whereby the whole tree, including limbs, is chipped in the forest, usually after the removal of the most valuable Roundwood segments). Whole-tree harvesting is not exclusively accompanied by in-woods chipping, as tree merchandizing may still occur at the landing. When in-woods chipping is used in conjunction with whole-tree harvesting, a significant component of the harvest unit may end up being chipped at the harvest site. The decision to use this approach often depends in large part on the quality of the stand itself, but also on local timber and fibre markets and the equipment selection of contractors. While market economics would seem to dictate

⁶⁴ Wood product supply chains can be significantly more complex than depicted in this process diagram. For a more in depth review of the wood supply chain see Qian & McDow, 2013 and Georgia Forestry Commission, 2012.

that higher-value roundwood would be sorted for other markets, the motive of whole-tree in-woods chipping operations is to fill the chip van as fast as possible, meaning some larger diameter roundwood may be used in reaching this objective. If tree quality is not sufficient to warrant extensive merchandizing, harvested Roundwood may be chipped onsite.

Small diameter roundwood is the most significant portion of large export oriented wood pellet mills. It is not completely clear how significant in woods chipping currently is in regards to the total supply volumes of export pellet mills in the region. The feedstock supply of Drax Biomass' Amite BioEnergy pellet plant in Mississippi, a 450,000 tonnes annual production capacity facility, is reportedly designed to include a proportion of roundwood to in-woods chips of 80:20 respectively (Donnell 2016). However, today the mill is bringing in exclusively pine pulpwood for processing into chips on site. Drax expects to ultimately bring in in-woods chips "once the manufacturing process has been optimized". Enviva's Ahoskie mill in North Carolina has been shown to utilize in-woods chips (Upton 2015).⁶⁵

Ash content of in-woods chips may be a limiting factor in the total proportion of the feedstock mix. Due to the difficulty in determining wood species or diameter, in-woods chipping may pose additional risks concerning net greenhouse gas effects of the bioenergy system and potential risks for biodiversity. Conversely, utilizing in-woods chips composed of logging residues and not roundwood could be among the most favourable biogenic feedstocks from a greenhouse gas emissions accounting perspective (US EPA 2012). For reasons of quality, however, the utilisation of in-woods chips for pellets remains marginal at best.

⁶⁵ <http://ccentralassets.s3.amazonaws.com/specialreports/pulp-fiction/videos/packages/making-of-a-pellet-720p.mp4>

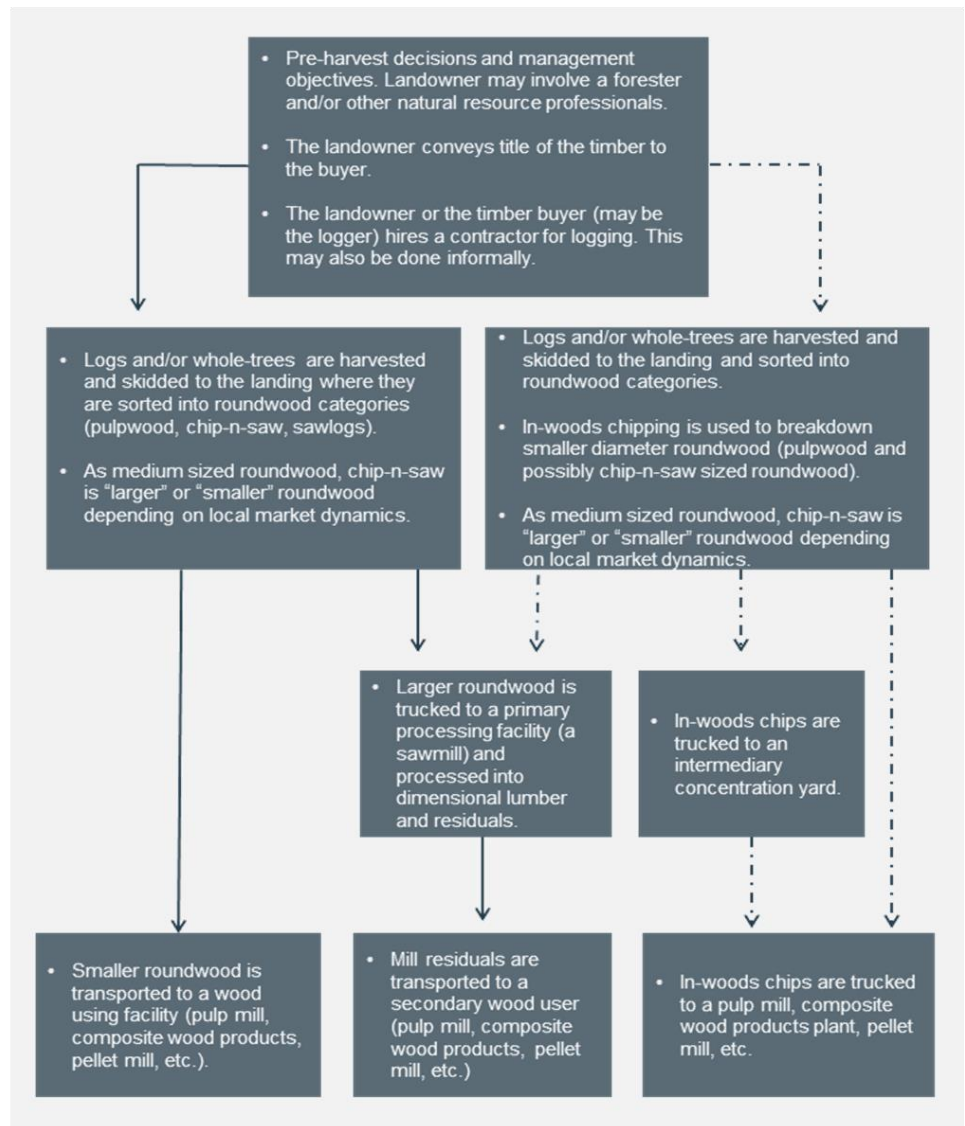


Figure 23. Simplified feedstock supply chain from the forest to utilization. Source: Own production, Pinchot Institute for Conservation.

Wood dealers

In addition to loggers and foresters, another role in the wood procurement process is that of the wood dealer. These entities serve as aggregators or intermediaries, linking wood harvested from thousands of parcels to market outlets with, or without, operating under formalized supply contracts with wood using facilities. For a number of reasons long-term supply agreements between industrial forest owners and pellet mills are preferable. For example, in 2013, Plum Creek, which has since merged with Weyerhaeuser, signed a 10-year supply agreement with Drax for supplying up to 770,000 green tons of feedstock annually to Drax’s pellet mills in Mississippi and Louisiana (Wood Bioenergy, 2013). The vast majority of this material is pine pulpwood.

While long-term supply agreements may be attractive for pellet mills and their financiers, these agreements rarely fully meet total facility demand, as is the case for Drax in the aforementioned example. In SFI Fiber Sourcing certification reporting, discussed in section 4, even companies with large forest ownerships supplement their supply through purchasing. While it varies from facility to facility, pulpwood using industries in the southeast US usually have at least 10 - 20% of their supply under long-term contract with wood dealers or industrial landowners, meaning that the overwhelming majority of supplies are not from long-term supply contracts (Stewart, 2014).

As intermediaries, wood dealers purchase harvested timber from landowners and/or loggers based on a negotiated stumpage price, usually indexed to regional markets. These transactions may be accompanied by a formal written contract or no contract beyond that of a verbal agreement between the landowner and a logging contractor. In turn, the loggers may themselves be a wood dealer or work with several dealers. Wood dealers may also operate chip mills (regional and semi-mobile wood chipping operations), especially if significant pulp and paper/packaging capacity is present. Intermediary suppliers within Southeast fibre markets are positioning themselves for a growing regional bioenergy industry. In 2013, the region's largest chip mill company, which is self-purported to supply 70% of the contracted wood chips in the region from 25 chip mills, was acquired by a bioenergy company pursuing the construction and acquisition of pellet mills across North America (Wood Bioenergy, 2013).

Feedstocks for wood pellets

Several different categories of biomass feedstock can be used for various energy technologies, including wood pellet production. Feedstocks include:

- › Wood product mill residues – The by-products of wood product operations such as sawdust, wood shavings, and chips. This is the cleanest form of feedstock and is preferable for pellets and other products. Mill residuals are also often the least expensive biomass source and are for the most part completely utilized by other industries. In the northeast US where pellet mills are typically small and designed to produce a bagged product for home heating, the industry developed in a symbiotic manner to utilize mill residuals from sawmills and other facilities. To use a higher percentage of mill residuals pellet mills need to be able to compete with other users, many of whom rely on such material in their own industrial processes for heat, electricity, or material needs.
- › Logging residues – These are the tops, limbs, and other non-merchantable materials made available for collection during roundwood timber harvests. These currently do not play a significant role. Recovery of logging slash post-harvest is not currently occurring in pellet supply chains (RISI 2015c).
- › Hardwood harvests generally generate twice (40%) as much residues as softwood harvests (20%) as a percentage of total above ground harvested biomass (Abt, 2014; Perlack et al., 2011). It is generally assumed that 60-65% of logging residuals (specifically limbs and tops) can be cost-effectively

recovered from harvests (Perlack et al., 2011). However, due to higher ash content, such residues are, at present, poorly suited for producing the high-quality industrial pellets required for European thermo-electric power plants.

- › Roundwood⁶⁶ – As feedstock for industrial pellets, this category can generally be considered non-sawtimber roundwood, or logs not used in sawmills. This generally includes pulpwood, other small diameter trees from thinning operations, low-priced chip-n-saw sized logs, and defect logs. Roundwood can be produced at several points during a forest rotation. In general, roundwood is the most expensive form of wood energy feedstock, with wood energy users competing directly with other entities for this feedstock. Roundwood classifications include:
 - › Pulpwood. Sections of stems from 23 Cm in diameter down to 5 – 10 Cm in diameter (debarked) and other material of this size, and in some instances un-merchantable fibre (rough and rotten). This category is typically available at \$6-10/green ton for stumpage
 - › Chip-n-saw. If prices are within pellet mill paying capacity, lengths of chip-n-saw sized material (23 – 28 Cm in diameter) or even larger can also be used. This category is typically available at \$10 - \$20/green ton for stumpage.
 - › Sawtimber. Typically not used for energy. Logs +28 Cm in diameter, typically available at \$25-40/green ton for stumpage.

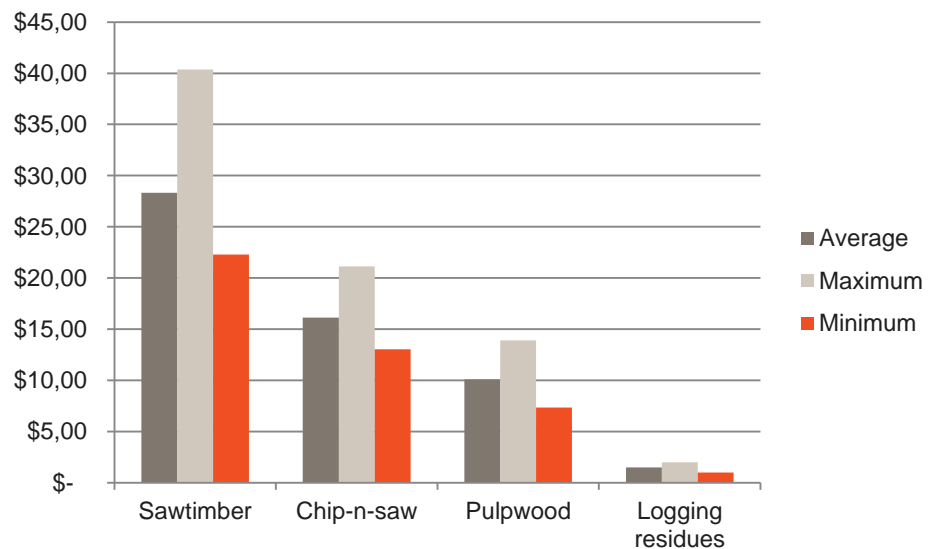


Figure 24. Stumpage price for various harvested wood categories. Source: Abt, 2014; Timber Mart South; Galik et al. 2009.

Pellet mills can utilize either hardwoods or softwoods. What drives pellet plant fibre selection is availability of the lowest cost lowest ash-content fibre and sustainability

⁶⁶ A categorization of roundwood by diameter is available here: <http://www.state.sc.us/forest/lecom.htm>.

criteria (e.g. positive-negative lists) where applicable. Typically, industrial pellet mills aim for ash content of 1 – 2%. This translates to logging residuals (tops and limbs) being less suitable for industrial wood pellets due to high ash content. Large industrial pellet mills may be designed to utilize as much as 20% of this feedstock type (Donnell 2016), but are not currently utilizing this feedstock category in any significant quantity (RISI, 2015c). Wood pellets used in power plants mostly require stem wood and logging residues that are low in bark, foliar components, or dirt. Research into utilization of logging residuals for production of so-called black pellets, via torrefaction pre-treatment processes continues, with small-scale commercialization efforts beginning in the southeast US.

Thus, roundwood that can feasibly be debarked (pulpwood sized roundwood or larger), typically comprises at least roughly three-quarters of the feedstock volume or more of a large industrial pellet facility. According to Forisk Consulting, across the entire southern pellet industry, including both large export mills and smaller mills supplying US markets, this feedstock split is roughly between pulpwood sized roundwood (53%) and wood products facility manufacturing residuals (47%). Forisk Consulting does not indicate that any logging residues (limbs and tops not feasibly debarked) are used to produce wood pellets.

Forisk Consulting estimates that wood pellet production capacity in the region will double by 2020 and that the feedstock component represented by softwood and hardwood pulpwood could increase to 73% for all wood pellets produced for either domestic or export markets. Under this forecast, most of the balance is comprised of mill residues, which are also used by the traditional composite panel and pulp and paper industry as a feedstock, and not by logging residues (Forisk Consulting, 2015a; Forisk Consulting, 2015b; Forisk Consulting, 2015c). Whereas RISI, another forest sector consultancy, estimates that 72% of industrial pellet supply is obtained from softwood and hardwood pulpwood, 17% is mill residuals, and 11% is logging residues (presumably from in-woods chipping) (RISI, 2015a; 2015b; 2015c). RISI also states that “Traditional pulpwood (roundwood stems with bark on, up to 55 feet in length to a roughly 2-3 inch top size) account for the largest share, by far—and for some pellet mills nearly 100% of furnish.” (RISI 2015c).

Definitions of merchantable timber products and logging residues overlap in the area of smaller roundwood typically obtained through thinning, as tree tops from pine, or otherwise during pulpwood harvest (RISI 2015c). This overlap in product definitions has been controversial as it directly relates to competition and synergies with other wood using industries. While revenue from sawtimber tends to be the driving force behind harvest decisions, the market for smaller diameter roundwood plays a role as well.

Enviva, the largest company exporting pellets to the EU from the US southeast defines logging residues as tree tops, limbs, branches, leaves, and needles; diseased, rotten, or malformed trees unsuitable for sawmills, trees removed during pine plantation thinning, smaller diameter trees cleared during final harvests. Based on the public reporting on feedstock categories by Drax Biomass (see Figure 25), this categorization appears to be commonly held across the main players in the industrial pellet export industry. While the industrial pellet sector holds to the notion of using logging residues, it appears that their definition for

logging residues is inclusive of pulpwood sized Roundwood that is used by other industries. The export pellet industry counters that new pellet mill fibre demand is replacing lost pulpwood demand and utilising surplus fibre.

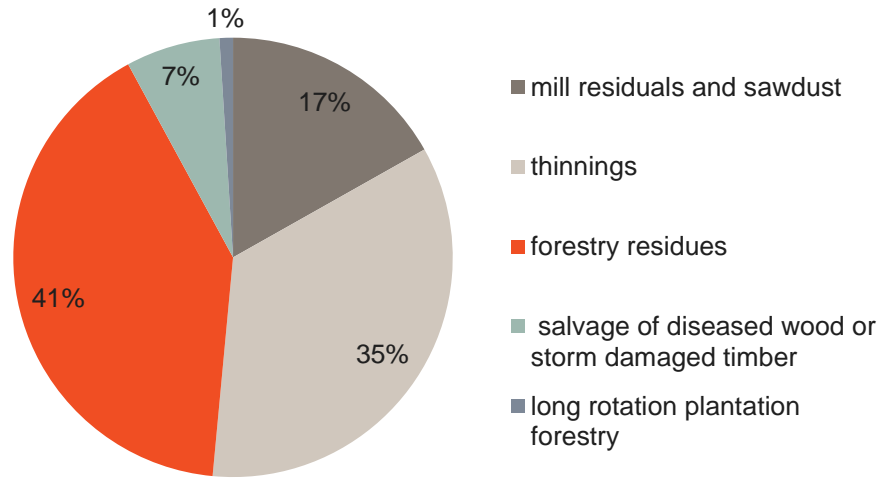


Figure 25. Feedstocks for Drax pellet supply. Source: <http://www.drax.com/media/56583/biomass-supply-report-2014.pdf>.

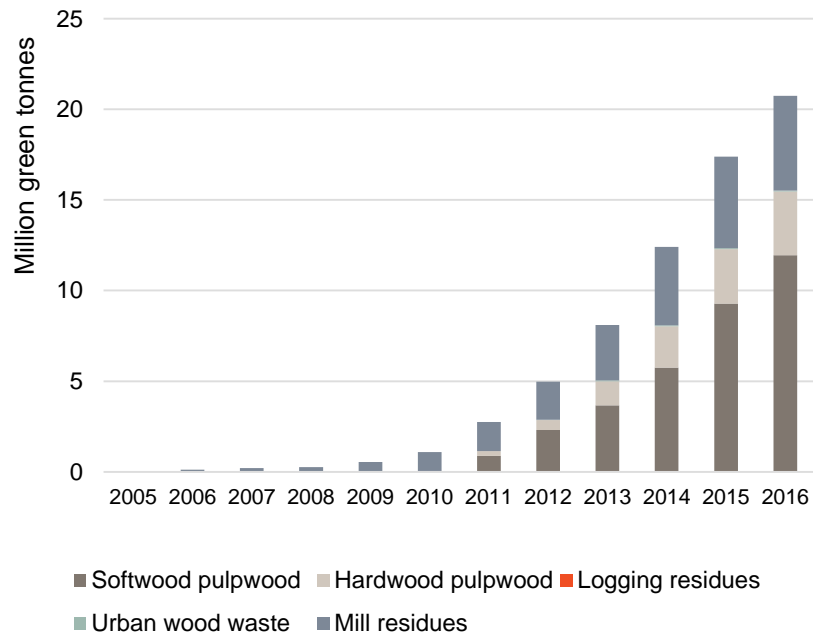


Figure 26. Actual and announced feedstock source for use in wood pellet production in the Southeastern US (2005 – 2016). Source: Adapted from Abt et al. (2014).

Industrial Wood pellet production process

While there is some variation, once wood is procured using the pathways described above, the general process for producing industrial wood pellets is fairly straightforward:

- 1 Intake. At the facility gate, trucks carry biomass to the gate where the contents are measured on an electronic weighbridge. This step may also include some basic quality control and/or due diligence on source of the material (i.e. checking the harvest receipt, load ticket or GPS coordinates of the harvest site).
- 2 Feedstock storage. Upon intake, feedstocks are stockpiled in a log yard as whole logs and chips.
- 3 Debarking. Pulpwood logs are loaded into a debarker, which removes bark prior to chipping and grinding to limit ash content in pellets.
- 4 Chipping. Following debarking the logs are run through a chipper and either stored in an intermediary area with feedstock brought into the facility previously chipped.
- 5 Drying. Chips are fed into a dryer to reduce wood moisture content from 45% to 12-15%. Bark and/or wood chips can be used to fuel the drying process.
- 6 Screening. Dry whole log white chips are then ran through screens to ensure proper sizing for the next step.
- 7 Grinder and/or Hammermill. Dry sized chips are then sent through a grinder and/or hammermill to break down the wood fibre into a wood dust roughly equivalent to sawdust.
- 8 Pelletizing. Wood dust is then passed through a wood die and compressed
- 9 Storage. Pellets are stored in silos or directly loaded into trucks, rail cars or barges, to be conveyed to export terminals.

Feedstock procurement pathways

Materials will have varying degrees of environmental risk relating to: (a) the ability to trace the load back to its origin (i.e. the point of harvest), (b) the ability to identify the composition of the material (e.g. Roundwood of x species and y diameter), and (c) the mix of practices used by supply chain actors before, during, and after the harvest. In current forest product markets, a higher percentage of gatewood⁶⁷ corresponds to a greater uncertainty on environmental risk. It is not clear to what degree gatewood factors into industrial wood pellet markets. Industrial pellet manufacturers in the southeast US have stated publicly that gatewood is not a

67 Gate wood refers to wood hauled to a mill that had not purchased it as standing timber, or that was not involved in a timber supply contract.

factor in their supply chains. However, NGO reports maintain that it is a significant source in the region.⁶⁸

Regardless of the supply chain strategy, feedstock for pellet mills is being sourced from the forests of the southeast through forest management and harvesting systems that are influenced by a combination of market forces, regulations, and non-regulatory programs. The mix of programs engages the various supply chain actors (landowners, loggers, foresters, wood dealers, pellet mill procurement officers) in different ways and at different points along the supply chain. Fibre sources and the pathways by which fibres reach market are more varied in the southeast than anywhere in the US, a feature which poses a challenge to the deployment of forest certification systems in the region.

In terms tracking feedstock origin for the purpose of risk management, the major procurement systems in operation in the US Southeast can be represented as four pathways (see Figure 27). These pathways involve forest management certification programs, risk-based approaches, inspections and documentation that verify wood as originating in harvests compliant with voluntary and regulatory forestry programs, and non-documentable and non-inspected wood. These pathways present varying levels of risk. In addition, at present none of these pathways currently integrate systems of full lifecycle GHG emissions accounting.

- › **Path 1 - Certified forest management.**
Forest management certification systems represent the pathway of lowest risk concerning most environmental risks.
- › **Path 2 - Controlled and mixed sourcing.**
Controlled and mixed sourcing involves risk assessment methods, outreach, education, and technical assistance procedures of the major certification systems to integrate materials that do not originate from lands that are certified.
- › **Path 3 - Inspected compliance for plans and practices.**
State agencies inspect logging operation and/or voluntary programs exist through which loggers are certified and have their performance evaluated against a standard.
- › **Path 4 - Uninspected forest operations.**
Raw material received from non-certified sources or sourcing systems providing less assurance.

The wood pellet supply chain involves numerous people making decisions, which ultimately can lead to supplies *presenting* or *preventing* risks. The programs reviewed in chapter 4 collectively comprise these four pathways—forest management certification systems, controlled and mixed sourcing risk assessments (risk-based fibres), 3rd party verification of sustainability practices and sustainable forestry, and unverified compliance of practices.

⁶⁸ <https://sosforetdusud.files.wordpress.com/2014/11/dossier-gardanne-fc3a9vri-2015-leger-def.pdf>

Figure 27 is to be read beginning at the pie chart, or the total potentially available feedstock supply in a pellet mill's supply area (in the chart this is the total certified and non-certified forest area in the entire US Southeast). A certain percentage of that supply will be certified to one of the major certification systems. For uncertified material, BMPs and BHGs applicable to the catchment area apply but may not be inspected as part of a regulatory approach. This uncertified portion of the supply chain presents higher risks to the pellet mill, although pathway 3 captures facility procurement systems, which may include some type of independent monitoring, and verification that harvests supplying the facility use BMPs and BHGs as applicable.

For certified feedstocks, these are either fully certified from the land-base through production (pathway 1) or using a mixture of certified and uncertified feedstocks (pathway 2) which is the most commonly used procurement system for existing pellet mills. Key to the risk mitigation effectiveness of pathway 2 are the various mechanisms of 3rd party auditing, education and training, record keeping, and proactive supply chain risk analysis.

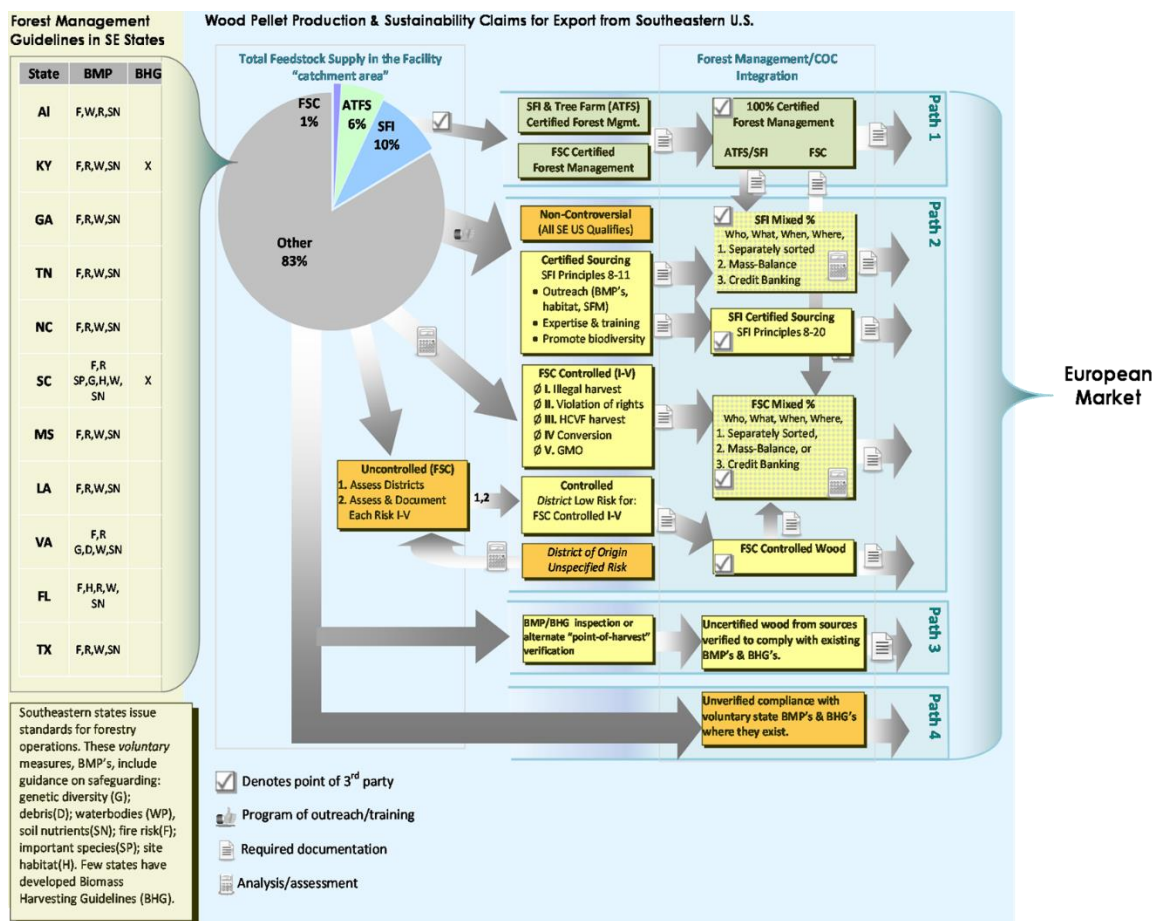


Figure 27. Four pathways of feedstock procurement in the Southeast. Source: Pinchot Institute.

5.2 Current and projected demand

5.2.1 Domestic/US demand (current + projected)

Solid biomass represents 2.2% of total primary energy and 23% of all renewable energy in the US (Aguilar, 2014). The current deployment of wood energy in the US Southeast is depicted in Table 5-1. The forest products sector is the most significant user of wood energy, producing upwards of three-quarters of its energy from mill residuals (sawdust, edgings, and shavings) and wood chips, to provide the heat and electricity needs of industrial processes and manufacturing. Most of the facilities in Table 5-1 are not dedicated bioenergy or densified solid biomass fuel (wood pellets) facilities but are wood products facilities that largely use their own residuals for heat and electricity production. The categories of facilities shown in Table 5-1 are derived from the wood2energy.org database.⁶⁹

Table 5-1. Number of existing wood energy facilities in wood2energy.org database. Source: <http://www.wood2energy.org/> (updated April 22, 2015).

| State | Liquid Biofuel | Pellets | Co-firing | Biopower | Sawmills | Pulp & paper mills | Chip mills | Wood-based manufacturing | Institutional and Commercial Wood Energy Users | Other (OSB, composite products, miscellaneous energy products, etc.) | TOTAL |
|----------------|----------------|---------|-----------|----------|----------|--------------------|------------|--------------------------|------------------------------------------------|----------------------------------------------------------------------|--------------|
| Alabama | 6 | 12 | 6 | 10 | 423 | 15 | 3 | 286 | 24 | 53 | 838 |
| Arkansas | 0 | 10 | 3 | 5 | 216 | 11 | 3 | 166 | 14 | 51 | 479 |
| Florida | 1 | 3 | 1 | 3 | 81 | 4 | 1 | 59 | 5 | 8 | |
| Georgia | 1 | 37 | 9 | 19 | 733 | 36 | 11 | 546 | 33 | 156 | 1,581 |
| Kentucky | 6 | 24 | 2 | 14 | 485 | 25 | 6 | 361 | 30 | 137 | 1,090 |
| Louisiana | 0 | 3 | 2 | 4 | 79 | 2 | 2 | 66 | 1 | 37 | 196 |
| Mississippi | 1 | 5 | 3 | 2 | 127 | 6 | 0 | 93 | 4 | 67 | 308 |
| North Carolina | 2 | 16 | 7 | 7 | 324 | 13 | 3 | 190 | 13 | 125 | 700 |
| South Carolina | 0 | 4 | 3 | 1 | 51 | 0 | 0 | 30 | 4 | 54 | 147 |
| Tennessee | 4 | 11 | 4 | 10 | 324 | 11 | 6 | 224 | 11 | 132 | 737 |

⁶⁹ For information on the quality of these data and the methodology of the wood2energy database see: http://www.wood2energy.org/NR/rdonlyres/FAC249C6-F44B-41EF-89F4-379E04566AF4/4145/Wood2Energy_DatabaseGuidelines1.pdf

| | | | | | | | | | | | |
|--------------|-----------|------------|-----------|-----------|-------------|------------|-----------|-------------|------------|------------|--------------|
| Texas | 1 | 21 | 0 | 20 | 285 | 23 | 4 | 230 | 21 | 55 | 660 |
| Virginia | 2 | 13 | 12 | 2 | 185 | 9 | 0 | 119 | 14 | 67 | 423 |
| TOTAL | 24 | 159 | 52 | 97 | 3313 | 155 | 39 | 2370 | 174 | 942 | 7,159 |

Table 5-2. Number of proposed or under construction wood energy installations of all types.
 Source: <http://www.wood2energy.org/> (updated April 22, 2015).

| State | # |
|----------------|-----------|
| Alabama | 4 |
| Arkansas | 0 |
| Florida | 14 |
| Georgia | 19 |
| Kentucky | 2 |
| Louisiana | 5 |
| Mississippi | 6 |
| North Carolina | 11 |
| South Carolina | 7 |
| Tennessee | 2 |
| Texas | 4 |
| Virginia | 11 |
| TOTAL | 85 |

Projected use of wood for electricity production in the US

Prior to the adoption of the US EPA’s Clean Power Plan and the Paris Agreement, there were very few policy drivers that would lead to southern states using significant quantities of wood for domestic energy production. While most states in the US have Renewable Portfolio Standard (RPS) policies, only three southern states do. Bioenergy plays a limited role in RPS compliance in two of these states, as Texas’ RPS is mostly met by wind and Virginia’s RPS caps the portion that can come from biomass. In 2006, the pulp and paper industry in Virginia, convinced the Virginia legislature to install a 1.5 million ton/year cap on the use of biomass by

utilities to meet the RPS.⁷⁰ As for North Carolina, analyses suggests that as biomass demand increases in response to the North Carolina RPA, availability of low cost biomass sources, logging residues and mill residuals will decrease, suggesting price spikes as more pulpwood will need to be sourced to meet demand (Galik et al., 2009; Abt et al., 2010).

In its 2015 Annual Energy Outlook, the US Department of Energy (DOE) projects increased growth in renewable energy production by 25% nationwide through 2018. DOE attributes this growth in part to RPS policies, federal tax credits, and other policy tools. After 2018, projected growth in renewables is forecasted to slacken until 2030 at which time growth in renewables again accelerates as natural gas prices are forecasted to increase (US DOE EIA, 2015). This forecast also includes an average annual increase in biomass-based⁷¹ energy production of 3.1% out to 2040.⁷² DOE assumes that co-firing at existing coal plants dominates new growth through 2030 and new biopower facilities thereafter.

These long-range projections using DOE's National Energy Modelling system were based on energy markets and existing policies (such as state-level RPS policies), and such projections are known to have significant error. Moreover, these projections were forecasted prior to the establishment of the EPA Clean Power Plan (CPP)—the key commitment by the US under the Paris Agreement--which if implemented, will likely have significant and long-term effects on the market for renewable electricity in the US.

As discussed in section 5.3.2, it is uncertain what impact EPA's CPP and biogenic carbon accounting framework, could have on the quantity of co-firing in the US energy sector. Upon release of the CPP, EIA used EPA's 0.08845 ton CO₂/MMBtu (0.08377 tonCO₂/GJ) emissions factor for wood biomass to forecast what level of biomass co-firing might occur as a result of CPP implementation (EIA, 2015). Under this assumption, which does not account for the timing of emissions recapture, EIA forecasts a significant reduction in the use of biomass in state implementation plants under the CPP, whereas EIA had previously forecasted significant increases in bioenergy (co-firing) out to 2040 when biomass is assumed to be a carbon neutral fuel.

⁷⁰ See *Protecting Our Fiber Supply*, at: http://bipac.net/rocktenn_2/state_fiber.pdf

⁷¹ Includes grid-connected electricity from wood and wood waste, non-electric energy from wood, and biofuels heat and coproducts used in the production of liquid fuels, but excludes the energy content of the liquid fuels. Note that DOE While the US DOE does not differentiate between wood and other forms of biomass, at least one assumption from the Southern Bioenergy Roadmap (Southeast Agriculture and Forestry Energy Resources Alliance 2009) is that 30% of biomass resources will come from forests. This 30% estimate is low as compared to current utilization and sourcing of the bioenergy industry in the south.

⁷² Note that these projections fluctuate from year to year. For instance, demand scenarios modelled by Abt et al. (2014) which are discussed in chapter 2 of this report assume a 4.4% increase in the use of biomass out through 2040 based on the US DOE 2014 Annual Energy Outlook.

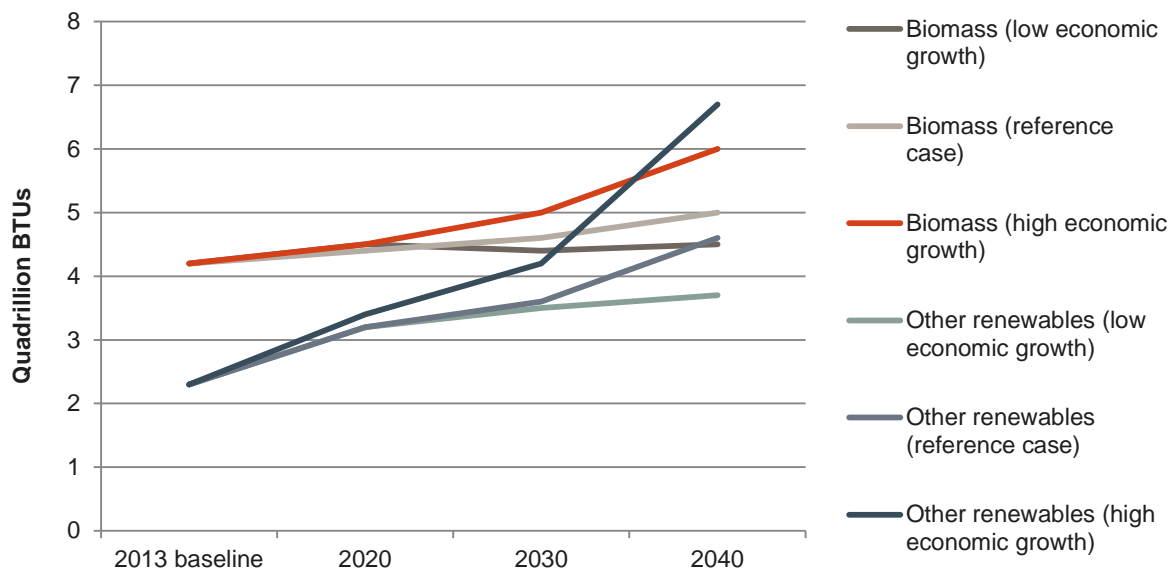


Figure 28. Renewable electricity generation biomass as compared to other non-hydropower renewables. Source: US DOE EIA (2015) Table B1.

5.2.2 Export/EU demand (current + projected)

US wood pellet manufacturing capacity has grown significantly in recent years. Countrywide pellet manufacturing capacity has expanded from an estimated 0.55 million tonnes in 2003, to 1.24 million tonnes in 2006, 4.6 million tonnes in 2009 and approximately 7 million tonnes by 2012. Most recent estimates suggest that by May 2015 installed capacity reached 9.1 million tonnes and by the end of 2015 this could top 11 million tonnes, with only a portion of this bound for export markets (Spelter & Toth, 2009; Aguilar, 2012; Biomass Magazine, 2015; see Table 5-3). Over three-quarters of US wood pellet capacity is found in the Southeastern US from which over 98% of US wood pellet exports are shipped (Abt et al., 2014). Reportedly, wood pellets have become the third largest wood product export from the US Southeast; behind softwood and hardwood lumber (Goetzl, 2015).

Table 5-3. Estimated number of wood pellet plants and manufacturing capacity in the US (by May 2015).

| Wood pellet plants | Number | Production capacity (Mt) |
|-------------------------------------------------------------|--------|--------------------------|
| Operational | 142 | 9,097,128 |
| Under construction | 10 | 1,586,666 |
| Proposed | 30 | 5,818,229 |
| All: Operating, in construction, and proposed pellet plants | 182 | 16,502,023 |

The US is the main exporter of wood pellets to the EU28. Imports of US wood pellets by the EU28 have grown from 0.53 million tonnes in 2009 to 3.89 million tonnes in 2014 (Eurostat, 2015a; Figure 29). As a point of reference total EU28

wood pellet production was 13.3 million tonnes in 2014, hence, US imports were equivalent to almost 30% of EU28 production. An estimated 97% of the value of all shipments of wood pellets exported from the US reached the EU28 in 2014 (UN Comtrade, 2015). International markets outside the EU for pellets are growing too (e.g. Japan, Republic of Korea) but represent only a fraction of current and expected future pellet demand (Aguilar, 2014). The production of industrial wood pellets for export quadrupled from an estimated 446,000 metric tons in 2010 to 1.8 million metric tons in 2012, then more than doubling to 3.9 million metric tons in 2014, and further rising in 2015.

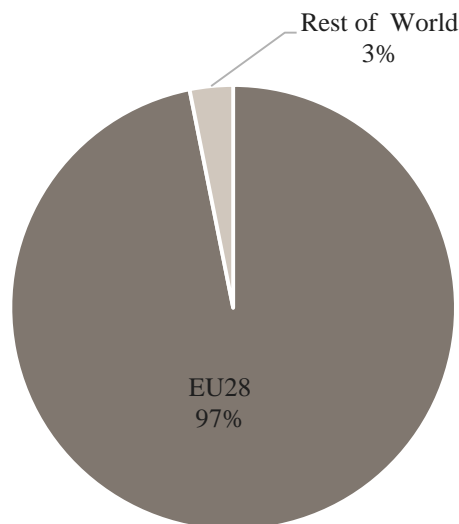
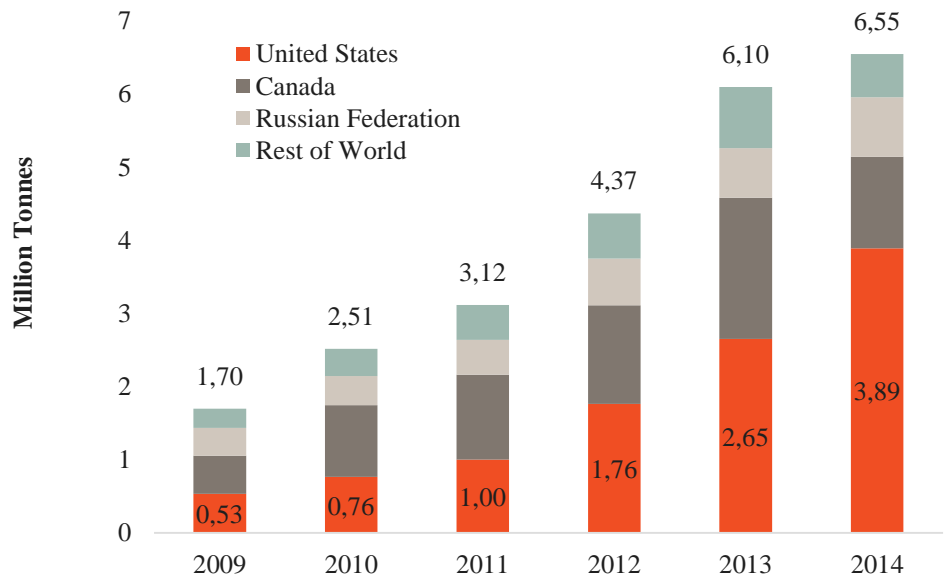


Figure 29. EU28 imports of wood pellets [HS 4401.30.20 (2009-2011) and HS 4401.31 (2012-2014)] and share of value of US exported wood pellets (Commodity '440131'). Source: Eurostat (2015a); UN Comtrade (2015).

The five largest importers of pellets from the US by tonnage are the UK, Belgium, Netherlands, Italy and Denmark. The importance of the UK market in particular has grown significantly in recent years and in 2014, it imported about 73.5% of all wood pellets exported by the US at about 2.91 million tonnes (Figure 30). Belgium and the Netherlands accounted for the second and third largest markets for US wood pellet exports but, in contrast to the UK, volumes have been in decline in recent years. Pellets imported by these countries are mainly used for power generation (Flach et al., 2014). Volumes of wood pellets imported from the US have been on the rise in Italy with the distinction that the Italian wood pellet market is largely dominated by residential heating uses instead of power generation. The importance of imported feedstock to the overall production of energy from solid biofuels in the EU28 continues to grow (Aguilar et al., 2015). Imported solid biofuels, comprised largely of pellets, generated about 7% of all primary energy production from solid biofuels in the EU28 in 2013 (Eurostat, 2015b). At present, imports account for 3.84% of European bioenergy production, with supplies from North America playing the largest role (AEBIOM, 2015).

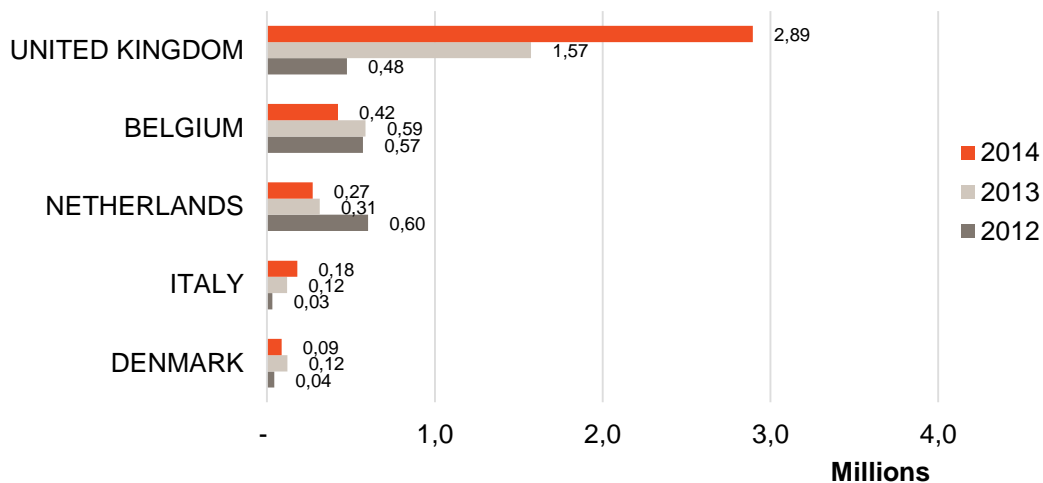


Figure 30. Top-five EU28 wood pellet US export markets. Source: Eurostat (2015a).

Projections for wood pellet production growth vary by source. Just over half of the total wood demand for all announced wood energy facilities in the US South is attributable to wood pellets (Abt et al., 2014). This represents a possible near-term demand of just over 20 million green tons for proposed wood pellets. Others projections range from a low of 9 – 27 million green tons up to a high of 49 million green tons by 2020 (Abt et al., 2014). Wood product market consultants seem to agree that European demand for wood pellets out to 2025 will likely be limited to 20 - 22 million metric tons, of which 10-12 million tons is likely to be sourced from the US. This is consistent with conservative low-end estimates presented in Table 5-4. If all of this demand were to come from pine pulpwood this new demand would equate roughly to an increase of as much as 45% of the current regional consumption of pine pulpwood for paper production. This change would occur in less than a decade.

Table 5-4. Forecasted range of supply needs for additional wood pellet and non-wood pellet bioenergy.

| Forecasted region and product | 2015 | 2020 |
|----------------------------------------------------------------|---------------------------|----------|
| | <i>Million green tons</i> | |
| US pellet production | 13 to 38 | 28 to 46 |
| US South pellet production (~4 million tons export in 2015) | 9 to 27 | 9 to 49 |
| US non-pellet bioenergy | 25 to 56 | 30 to 68 |
| US South non-pellet bioenergy | 6 to 21 | 10 to 29 |

Source: Adapted from Abt et al., 2014. (Cocchi, 2011; Forisk Consulting, 2014; RISI, 2013)

5.3 Overview of existing federal and state policies governing the use of biomass for energy

This section includes a brief overview of the major Federal⁷³ and state⁷⁴ policies influencing the use of forest biomass for energy in the US. Since, most states in the southeast have limited policies affecting forest bioenergy this section focuses mainly on Federal policies. Most state-level bioenergy incentives are currently offered in terms of tax credits. Several states also provide Renewable Energy Production Credits to supplement the Federal programs. Some state governments offer grant, loan, and cost-share programs to support renewable energy broadly. The most significant state policies affecting demand growth for forest bioenergy are RPS policies that mandate electric power producers to establish a minimum percentage of their capacity as renewable. At present, there are no major policies that directly address the production of wood pellets.

5.3.1 Federal energy policies

Federal definitions of biomass

At the federal level, a number of policies define “renewable biomass” to determine whether energy produced using specific types of biomass qualify for federal incentives (e.g. the federal renewable electricity production tax credit). In fact, there are as many as 16 definitions of biomass in federal policy.⁷⁵ The two main definitions of consequence are included in the Food, Conservation, and Energy Act

⁷³ Federal policies are available here: <http://programs.dsireusa.org/system/program?state=US>

⁷⁴ State policies are summarized in Becker and Lee (2008) and are available here: <http://www.dsireusa.org/>

⁷⁵ For an in depth review of biomass definitions see: <https://www.fas.org/sgp/crs/misc/R40529.pdf>

of 2008 (2008 Farm Bill, P.L. 110-246 et seq.)⁷⁶ and the 2007 Energy Independence and Security Act (EISA) (P.L. 110-140).

The EISA definition focuses on liquid biofuels for transportation, requiring that any woody biomass being used to meet the Federal Renewable Fuels Standard (RFS) comes only from non-Federal and non-ecologically sensitive lands. Additionally, under EISA, biofuels using forest biomass can only qualify for production subsidies if forest biomass feedstocks come from certain categories: (a) Roundwood and mill residue from existing tree plantations; (b) slash and precommercial thinnings; or (c) wildfire hazard reduction materials on private lands.

The EISA, as the main policy on renewable transportation fuels in the US, will affect pellet production only if cellulosic biofuels become a commercially viable product and begin to affect timber harvest levels, and/or if international policies or subsequent domestic policies use the EISA biomass feedstock definitional limitations as a basis for their own sustainability criteria. As regulated by the US EPA, EISA also includes provisions to monitor land-use change. The Farm Bill definition is much broader than EISA with significantly fewer prohibitions on feedstock source. This definition applies to various Farm Bill incentives and is not tied to any single end use or production mandate the way that EISA is tied to the RFS and biofuels.

Incentives and subsidies

Federal Renewable Energy Production Tax Credit (PTC)

The federal Renewable Electricity Production Tax Credit (PTC) authorizes a per-kilowatt-hour tax credit for the production of renewable energy in the amount of \$0.011 per kWh for open-loop biomass (biomass from sources other than plantations) and \$0.22 for closed-loop biomass (biomass from plantations) (26 USC § 45). Biomass combusted through co-firing is presently ineligible for the PTC. The duration of the PTC is 10 years for closed-loop biomass and five years for open-loop biomass. The PTC is a key federal incentive for electric biopower production.

Business Energy Investment Tax Credit (ITC)

Unlike the PTC, the amount of the ITC allowable for an open-loop biomass facility is the same as that allowed for a closed-loop facility. The federal Business Energy Investment Tax Credit includes provisions for micro-turbines, up to 2 MW with an electricity-only generation efficiency of 26% or higher and CHP systems, that are at least 60% efficient up to 50 MW in size. The efficiency requirement does not apply to CHP systems using biomass for 90% or more of the system's energy source, but the credit may be reduced for less-efficient systems (26 USC §48).

Biomass Crop Assistance Program (BCAP)

76 The most recent Farm Bill is available here: <http://www.gpo.gov/fdsys/pkg/PLAW-113publ79/html/PLAW-113publ79.htm>.

BCAP subsidizes the transport of biomass to electricity, CHP, thermal, and biofuel facilities. To access BCAP subsidies, strict sustainability procedures need to be followed. BCAP is a Farm Bill energy program that provides up to \$25 million per year to encourage and assist producers with biomass production.

The BCAP subsidy is not likely to directly affect export pellet markets, although the subsidy may indirectly affect related market structures and prices. This is because, under BCAP, only biomass going to a Qualified Biomass Facility that converts biomass into heat, power, bio-based products or advanced biofuels is eligible. While pellet plants often use biomass to power industrial processes, pellet plants are generally not considered 'Qualified Biomass Facilities' under BCAP.

Moreover, while the current BCAP rules do not draw a distinction between domestic or foreign markets for the use of biomass, the program specifies that biomass must be delivered to Qualified Biomass Facilities to receive subsidy payments; however, at this point there are not any Qualified Biomass Facilities in the EU meet BCAP's rules.

Production mandates

Energy Independence and Security Act of 2007

The Energy Independence and Security Act (EISA) of 2007 (P.L. 110-140) includes a number of provisions related to the production of biofuels, including an expansion of a national Renewable Fuel Standard (RFS). The RFS mandates the production and use of 36 billion gallons of biofuels to be produced per year by 2022, 21 billion gallons of which are to come from advanced liquid biofuels. Of this volume of advanced biofuels, 16 billion gallons are supposed to come from cellulosic ethanol produced from lignocellulosic feedstocks such as wood fibre. In EISA, the US Congress mandated that 100 million gallons of cellulosic ethanol had to be blended into the fuel supply in 2010, 250 million gallons in 2011, and then 16 billion gallons per year by 2022. In 2010 and 2011 there was no cellulosic biofuels produced in the US, and from 2012 to 2013, there was only about 250,000 gallons of cellulosic ethanol produced by companies that subsequently declared bankruptcy.

In the first half of 2015, only 971,527 gallons of cellulosic biofuel has been produced in recently constructed commercial-scale facilities with a combined nameplate capacity of about 58 million gallons.⁷⁷ If production continues at current levels, by the end of 2015 commercial scale ethanol plants will be operating at just a little over 3% their nameplate capacity. The vast majority of feedstock for these facilities is agricultural residues (e.g. corn Stover).

EPA regulations

Regulations of the US Environmental Protection Agency (EPA) have the potential to significantly change the degree to which the US uses wood for energy. EPA's Clean Power Plan (CPP) is set to limit CO₂ emissions from existing power plants,

⁷⁷ <http://www.epa.gov/otaq/fuels/rfsdata/2015emts.htm>

which account for almost 40% of US CO2 emissions. Discussed further below, the CPP intends to reduce emissions by 32% from the power sector by 2030, compared to 2005 levels. Several industries and states are looking to block EPA from doing this.

Table 5-5. Key policies from US EPA regulating biomass.

| |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EPA National Emission Standards for Hazardous Air Pollutants: Off-Site Waste and Recovery Operations—Proposed Rule. 79 Fed. Reg. 37850 (proposed July 2, 2014) (to be codified at 40 CFR pt. 63). http://www.regulations.gov/#/documentDetail:D=EPA-HQ-OAR-2012-0360-0001 . |
| EPA Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units. (Clean Power Plan) Proposed Rule. 79 Fed. Reg. 34830 (proposed June 18, 2014) (to be codified at 40 CFR pt. 60). http://www.gpo.gov/fdsys/pkg/FR-2014-06-18/pdf/2014-13726.pdf |
| EPA National Emissions Standards for Hazardous Air Pollutants for Area Sources: Industrial, Commercial, and Institutional Boilers. Final Rule. 78 Fed Reg. 7487. 40 CFR Part 63. https://federalregister.gov/a/2012-31645 . |
| Clean Air Act of 1970. Pub. L. 159 (July 14, 1955) 69 Stat. 322, and the amendments made by subsequent enactments. 42 U.S.C. 7401–7626. http://www.epw.senate.gov/envlaws/cleanair.pdf . |
| EPA Commercial and Industrial Solid Waste Incineration Units: Non-Hazardous Secondary Materials That Are Solid Waste—Final Rule. 78 Fed. Reg. 9112 (February 7, 2013). 40 CFR Parts 60 and 241. http://www.regulations.gov/#/documentDetail:D=EPA-HQ-RCRA-2008-0329-1981 . |
| Resource Conservation and Recovery Act of 1976. Pub. L. 94-580. 90 Stat. 2795. 42 USC 82 part 6901. http://www.gpo.gov/fdsys/pkg/STATUTE-90/pdf/STATUTE-90-Pg2795.pdf . |
| US EPA Biogenic carbon accounting framework – <i>In development</i> http://www.epa.gov/climatechange/ghgemissions/biogenic-emissions.html |

5.3.2 Regulations on biogenic carbon accounting

US forests are on the balance serving as a carbon sink, accumulating approximately 10% of net US annual CO₂e emissions (Melillo et al. 2014). Southeastern forests play an important role in this; accounting for about 36% of the carbon sequestered annually in the conterminous US (Coulston et al., 2015). Additional harvests for wood pellets will reduce carbon stocks in the short-term and the long-term effects of additional demand on carbon stocks across the landscape are uncertain.

Perspective on the timing of carbon sink losses and radiative forcing is important. US forests have returned about a third of the carbon lost prior to historic deforestation (Ryan et al. 2010). Whereas when looking at the situation over a shorter timeframe and a smaller spatial-scale, carbon stocks within intensively managed pine plantations are more or less stable (Heath et al. 2010). In addition,

during the last three decades of the 1900s the rate of carbon storage in the South, while still positive, slowed due to increased harvesting and urbanization (Liu et al. 2004; Zhang et al. 2015). Going forward bioenergy could have a significant impact on the regional carbon balance.

Science debate on carbon reduction benefits of forest bioenergy

Calculating the net GHG emissions/reduction from forest bioenergy is complicated. Most studies on the life cycle effects of forest bioenergy identify a temporal imbalance between when biogenic carbon is emitted and when any resulting sequestration can subsequently compensate for these emissions. Others further specify that sequestration post emissions only compensates for the emissions from bioenergy to the extent that this sequestration is additional to what would happen in the absence of the market influences of the bioenergy system on the landscape. Since initial combustion emissions of bioenergy are per-unit energy higher than those of fossil fuel alternatives, GHG benefits only result following the harvest and combustion of biomass if increased sequestration occurs post-harvest at a level sufficient to compensate for the excess emissions from bioenergy to the extent that this sequestration is additional to (higher than) what would happen in the scenario that fossil fuel use were to continue and the harvesting/collection of biomass were not to occur (EEA, 2011; Searchinger et al., 2009; Searchinger, 2010; Walker et al., 2010; US EPA, 2012). This perspective contends that GHG emission reduction benefits of bioenergy can be significantly delayed and reduced (or even eliminated) when carbon sequestration or emission reduction benefits are insufficient. As was noted by the European Environment Agency (EEA) Scientific Committee, whether or not significant GHG emissions reductions can be achieved depend on biomass type and source, including aspects on where and how the biomass is produced and harvested (EEA SC, 2011).

Nevertheless, most authors conclude that forest bioenergy can present long-term reductions in atmospheric CO₂ emissions (Miner et al., 2014; Ter-Mikaelian et al., 2015; Buchholz & Gunn, 2015; Lamers et al., 2013; Helin et al., 2013; Marland et al., 2013; Buchholz et al., 2015). With many pointing to the potential for increased sequestration at a landscape level yielding benefits over the long-term, as well as, the role of market forces that incentivize a planting response (Malmshaimer et al. 2011; Miner et al., 2014; Ter-Mikaelian et al., 2015; EPA, 2012).

The structure and underlying assumptions of biogenic carbon analyses matter as assumptions and analytical frameworks will yield different results. This was confirmed in recent meta-analyses of forest bioenergy GHG emissions accounting studies globally (Buchholz et al., 2015; Miner et al., 2014; Ter-Mikaelian et al., 2015). Key variables related to the carbon payback period of forest bioenergy in many studies include the type of biomass feedstock (e.g. residues vs. whole trees), efficiency of energy conversion, fossil fuel displaced, forest management variables, the impact of biomass harvesting on forest product markets, land-use change, and fibre markets, and analysis of counter-factual scenarios (i.e. what would have happened in the absence of added demand from bioenergy) (Dale et al., 2015; Nepal & Skog, 2014). Key factors in such analyses are summarized in appendix D. The EEA SC in their opinion on GHG accounting in relation to bioenergy (2011) furthermore noted that the assumption that “biomass combustion would be

inherently „carbon neutral“ is not correct, as issues concerning carbon payback time can significantly affect the effect which the atmosphere sees.

Several recent reports attempt to characterize the carbon payback issue and frame it for policy makers (Agostini, 2013; Stephenson & MacKay, 2014; US EPA, 2012; Walker et al., 2010; Matthews et al., 2015). These and other reports generally conclude that when logging residues are used net GHG benefits of wood for energy systems likely result within a few decades of the commencement of the activity (such as the collection of previously unused residues that would otherwise soon give up their emissions).

Some suggest that GHG benefits can be achieved in similarly modest timeframes in scenarios with short-rotation trees and when landowner investment response is strong (Malmshemer et al., 2011; Miner et al., 2014; Ter-Mikaelian et al., 2015; Walker et al., 2010). Conversely, when regeneration is lacking because of low investment response or other factors, or when large or slow-growing trees grown in long-rotations are used as energy feedstock, carbon benefits may not materialise in an acceptable timeframe (Ter-Mikaelian et al., 2015; Buchholz & Gunn, 2015; Colnes et al., 2012; Walker et al., 2010; Stephenson & MacKay, 2014; US EPA, 2012) or at all if subsequent sequestration and storage does not compensate for the increased emissions from combustion (EEA, 2011; Searchinger et al., 2009; Searchinger, 2010).

Regulatory timeline – Biogenic carbon accounting

In the US, several significant events have occurred in the last half decade leading to a process by which EPA will likely define how GHG emissions from biomass fuels are to be treated. Key events in this timeline are briefly summarized here.

Massachusetts regulations of biomass fuels

In 2010, the State of Massachusetts commissioned a *Biomass Sustainability and Carbon Policy*, commonly known as the “Manomet Study” (Walker et al. 2010).⁷⁸ The study presented a carbon debt-then-dividend framework for evaluating the temporal aspects of biogenic emissions in Massachusetts as they pertained to the state’s renewable energy and GHG reduction policies. The study analysed a range of energy technologies and biomass feedstock mixes, land management scenarios, and fossil fuel scenarios being substituted. The modelling for the study analysed the interplay of four components effecting net GHG emissions and the debt-then-dividend construct: (1) biomass feedstock source, and specifically, what would have happened to the material in the absence of biomass energy generation, (2) efficiency of energy technologies and resultant GHG emission profiles, (3) fossil fuel displaced, and specifically the emissions profiles of coal, oil and natural gas, as compared to combusted wood, and (4) forest management regimes, and how management decisions affect recovery rates of carbon in new growth following combustion.

⁷⁸ <http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/biomass/biomass-sustainability-and-carbon-policy-study.html>

Using this framework, the study found that per unit energy output, biomass fired electric power, thermal, and combined heat and power produce more GHG emissions than fossil fuel fired energy, and that a carbon debt results for a period before emitted carbon is sequestered in new growth. The magnitude of this debt varied significantly depending on modelled scenarios. For instance, when compared to coal-fired electric power, using logging residues was found to provide relatively short payback periods (10 years) before carbon reduction benefits are realized, as composed to a mix of Roundwood and residues, which were found to have longer payback periods (45-75 years).

Following this study, the state adopted a pseudo-precautionary approach with the adoption of regulations for the use of biomass fuels in 2012. Under Massachusetts' regulations⁷⁹ biomass fuels are only eligible if the origin of the fuel is tracked and if the following "eligible biomass fuels"⁸⁰ are used: forest derived residues, forest derived thinnings, forest salvage, non-forest derived residues, or dedicated energy crops. The state has also taken steps to provide additional incentives to reward efficiency improvements, such as favouring combined heat and power generation versus less efficient stand-alone electric power generation or co-firing.

EPA biogenic carbon accounting framework

Late in 2010, EPA issued a GHG Tailoring Rule, which focused on tailoring GHG emission rates for various fuels for use in Clean Air Act regulations. As forest biomass feedstocks emit more GHGs per unit energy than fossil fuels and since the Clean Air Act and the Tailoring Rule required EPA to regulate stack emissions rather than lifecycle emissions, the nature of emissions profile and timing of emissions mitigation, i.e. the recapture in new growth unique to biogenic feedstocks, became a major policy conundrum for EPA.

Under the Tailoring Rule, EPA could not distinguish between biogenic carbon and fossil carbon, in part because the Clean Air Act does not consider land use. Instead, the agency began a multi-year process⁸¹ to address the question of how to account for stationary source (power plant) biogenic GHG emissions, incorporating the biological cycling of carbon. The process of developing a biogenic carbon accounting framework (The Framework) implicitly feeds into EPA's process for regulating GHG emissions under the Clean Air Act vis-à-vis the CPP. The Framework process remains ongoing. Presented here is a brief catalogue of the major elements and points of contention surrounding the Framework.

In 2011, several forest product trade groups and companies petitioned⁸² EPA regarding the treatment of forest biogenic carbon accounting; their contention being, biomass fuels should be considered carbon neutral as long as carbon stocks on the landscape are increasing. This led to the issuance of a three-year deferral by EPA in July 2011, postponing any rule making related to biogenic

⁷⁹ <http://www.mass.gov/eea/docs/doer/renewables/biomass/225-cmr-14-00-final-reg-doer-081712-clean-copy.pdf> Additional details on the Massachusetts policy process can be found here: <http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/biomass/>

⁸⁰ These are further defined in the regulation.

⁸¹ <http://www.epa.gov/climatechange/ghgemissions/biogenic-emissions.html>

⁸² <http://nafoalliance.org/images/issues/carbon/legal/intervenors-response-6-21-2012.pdf>

carbon. During this three-year deferral, the EPA formed an independent Scientific Advisory Board (SAB) to advise the agency on carbon accounting. EPA also developed and released a draft biogenic accounting framework⁸³ in September 2011, which initiated a technical review by the scientists comprising the SAB.

The initial draft of the Framework focused on developing an approach capable of “adjusting” biogenic carbon emissions based on the lifecycle GHG emissions of various types of biomass. Given their regulatory authority under the Clean Air Act the EPA had three options, an “adjusting” approach, a categorical inclusion (treating biogenic feedstocks as equivalent to fossil fuels), or a categorical exclusion (excluding biogenic emissions from determining applicability thresholds for regulation). The adjusting approach was pursued because it is viewed as the most scientifically defensible option and because it is consistent with EPA’s regulatory authorities under the Clean Air Act, to regulate pollutants at the point of combustion and emission, and not in other areas of the fuel life-cycle (the land sector) which ultimately impact the net damages caused by their emission.

In the initial draft Framework, the adjusting approach introduced a method for calculating the net GHG emissions for various biogenic feedstocks by accounting for rates of re-sequestration in new growth and by also accounting for emissions that would have occurred without removal of the feedstock for energy production. The initial Framework referred to this approach as the Biogenic Accounting Factor (BAF). EPA also chose to use a reference point baseline as opposed to a dynamic baseline which would incorporate market effects and detailed counterfactuals analysis. The selection of baselines subsequently became a point of intense debate within the SAB.

In 2012, the SAB delivered its technical review of the initial Framework.⁸⁴ This SAB review documents in great detail the various points of debate concerning the accounting of the net GHG emissions of forest bioenergy. The main points are summarized briefly here with selected text from the SAB review.

First, SAB weighed in on the question of whether bioenergy can categorically be considered carbon neutral, finding that:

- › *Carbon neutrality cannot be assumed for all biomass energy a priori. There are circumstances in which biomass is grown, harvested and combusted in a carbon neutral fashion but carbon neutrality is not an appropriate a priori assumption; it is a conclusion that should be reached only after considering a particular feedstock’s production and consumption cycle. There is considerable heterogeneity in feedstock types, sources and production methods and thus net biogenic carbon emissions will vary considerably. Of course, biogenic feedstocks that displace fossil fuels do not have to be carbon neutral to be better than fossil fuels in terms of their climate impact.*

⁸³ <http://www.epa.gov/climatechange/Downloads/ghgemissions/Biogenic-CO2-Accounting-Framework-Report-Sept-2011.pdf>

⁸⁴ [http://yosemite.epa.gov/sab/sabproduct.nsf/0/57B7A4F1987D7F7385257A87007977F6/\\$File/EPA-SAB-12-011-unsigned.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/0/57B7A4F1987D7F7385257A87007977F6/$File/EPA-SAB-12-011-unsigned.pdf)

The SAB concluded that the first draft of the Framework includes most of the elements needed to measure changes in CO₂ emissions, but that the selection of a reference point approach is inadequate for providing an estimate of both the net additive emissions and sequestration changes resulting from biomass feedstock demand. According to the SAB:

- › *Estimating additionality, i.e., the extent to which forest stocks would have been growing or declining over time in the absence of harvest for bioenergy, is essential, as it is the crux of the question at hand. To do so requires an anticipated baseline approach. Because forest-derived woody biomass is a long-rotation feedstock, the Framework would need to model a “business as usual” scenario along some time scale and compare that carbon trajectory with a scenario of increased demand for biomass. Although this would not be an easy task, it would be necessary to estimate carbon cycle changes associated with the biogenic feedstock. In addition, an anticipated baseline would be needed to estimate additional changes in soil carbon stock over time. In general, the Framework should provide a means to estimate the effect of stationary source biogenic feedstock demand, on the atmosphere, over time, comparing a scenario with the use of biogenic feedstocks to a counterfactual scenario without the use of biogenic feedstocks.... For forest-derived Roundwood, carbon debts and credits can be created in the short run with increased harvesting and planting respectively but in the long run, net climate benefits can accrue with net forest growth. While it is clear that the agency can only regulate emissions, its policy choices about regulating emissions will be better informed with consideration of the temporal distribution of biogenic emissions and associated carbon sequestration or avoided emissions.*

Additionally, the SAB review addresses “EPA’s concerns about applying the IPCC approach to biogenic CO₂ emissions from the energy sector at individual stationary sources.” The IPCC Inventory Guidelines are used to report emissions and removals at the national level, counting biogenic emissions in the land use, land-use change, and forestry (LULUCF) sector, and not at the point of discharge (like the energy sector). The question is whether it is appropriate to ignore these emissions from energy sources in a regulatory context that does not include or otherwise consider emissions or removals from LULUCF: One dissenting member of the SAB was sympathetic with the IPCC approach, expressing that EPA should abandon the Framework and exempt biogenic CO₂ emissions from GHG regulations so long as aggregate measures of land-based carbon stocks are steady or increasing. However, the rest of the scientists on the SAB panel did not agree with this opinion, and the official SAB report acknowledges that:

- › *This is not the general consensus view of the SAB. The IPCC approach to carbon accounting would not allow for a causal connection to be made between a stationary facility using a biogenic feedstock and the source of that feedstock, and thus cannot be used for permit granting purposes. Also, the IPCC approach would not capture the marginal effect of increased biomass harvesting for bioenergy on atmospheric carbon levels.*

Further, SAB found that:

- › *While the IPCC approach can be used to determine if stock of carbon is increasing or decreasing over time, it cannot be used to determine the net impact of using a biogenic feedstock on carbon emissions as compared to what the emissions would have been if the feedstock had not been used. If EPA were to apply the IPCC approach, as long as carbon stocks are increasing, bioenergy would be considered carbon neutral. Under this approach, forest carbon stocks may be increasing less with the use of bioenergy than without but forest biomass would still be considered carbon neutral. Application of the IPCC accounting approach is not conducive to considering the incremental effect of bioenergy on carbon emissions*

Given that the SAB expressed a belief that the dynamic baseline approach is preferable for carbon accounting, the SAB also reported to EPA about the difficulties of accounting for leakage, both bad leakage and good leakage when using a dynamic baseline.⁸⁵ On this matter, SAB ultimately concluding that attempting to control the indirect land use change effects and other market-based leakage into GHG regulations would be too cumbersome, and that the issue of leakage is better addressed through companion rules, e.g. land use laws, many of which are likely outside the jurisdiction of EPA.⁸⁶

Upon their initial review, the SAB included the following key recommendations for revising the initial Framework:

- › Develop a separate BAF equation for each feedstock category as broadly categorized by type, region, prior land use and current management practices. SAB felt that default values could be developed for each scenario in a similar manner to that used by the UK Department of Energy and Climate Change (Stephenson & MacKay, 2014).
- › SAB recommended that some differentiation between residue waste feedstocks and “long-accumulation feedstocks like Roundwood” is necessary, and that accounting for long-accumulation feedstocks requires a dynamic baseline approach, “to capture the complex interaction between electricity generating facilities and forest markets and landscape level effects, in particular: market driven shifts in planting, management and harvests; induced displacement of existing users of biomass; land use changes, including interactions between agriculture and forests; and the relative contribution of

85 SAB defines leakage saying: “Bad” leakage (called “positive” leakage in the literature) occurs when the use of biogenic feedstocks causes price changes which, in turn, drive changes in consumption and production outside the boundary of the stationary source, even globally, that lead to increased carbon emissions....”Good” leakage (called “negative” leakage in the literature) could occur if the use of biomass leads to carbon-offsetting activities elsewhere. The latter could arise for example, if increased demand for biomass and higher prices generate incentives for investment in forest management, beyond the level needed directly for bioenergy production, which increases net forest carbon sequestration.

86 As discussed elsewhere in this report, land use laws in the US are mainly locally defined by state and county governments.

different feedstock source categories (logging residuals, pulpwood or Roundwood harvest).”

- › For residues and waste streams, SAB recommended full accounting of alternate fates and use of appropriate decay rates for each residue category. SAB also advised that “for feedstocks that are found to have relatively minor impacts, the agency may need to weigh ease of implementation against scientific accuracy.” Recent events discussed below suggest that that EPA may be heeding this advice.
- › The SAB also explored the use of certification systems and existing GHG accounting measurement protocols developed for the forest sector by carbon registries, for their utility in the Framework. The SAB found that in theory certification systems could be used to quantify many of the elements identified in the Framework but the SAB did not recommend the adoption of a certification-based approach without further analysis of how such systems would treat many of the same data and implementation problems challenging the Framework.

Following the SAB critique, EPA revised the Framework and in November 2014, the agency released an updated version of the Framework.⁸⁷ Like the first version, the updated Framework also described the variables and methodologies to be used when assessing biogenic GHG emissions, however, the updated Framework also presents an equation that EPA suggests could be used to calculate the net lifecycle GHG emissions of a regulated facility using biomass fuels. The revised Framework also includes in an appendix with the application of this calculation within the context of a dynamic baseline approach and regional case studies with multiple feedstock pathways. The revised framework also incorporates alternative fates for waste feedstocks and residuals as recommended by SAB. Upon its release, EPA offered a presentation⁸⁸ to SAB outlining its new Framework.

Also upon release of the updated Framework, EPA issued a memorandum, commonly referred to as the “McCabe memo.”⁸⁹ The McCabe memo indicates that the updated Framework would undergo additional SAB review. Through this memo, EPA signalled for the first time that the use of waste-derived feedstocks and certain forest-derived residuals are likely to have minimal or no net atmospheric contributions of GHGs. The memo further declares that EPA intends to apply this logic within its policy making, specifically saying:

- › *In the implementation of the Clean Power Plan, the EPA anticipates that some states will wish to include the use of biogenic feedstocks in their compliance plans. When considering state compliance plans, the Agency expects to recognize the biogenic CO2 emissions and climate policy benefits of waste-*

⁸⁷ <http://www.epa.gov/climatechange/downloads/Framework-for-Assessing-Biogenic-CO2-Emissions.pdf>

⁸⁸ [http://yosemite.epa.gov/sab/sabproduct.nsf/2C793C16C629B8C185257E12006E5FE3/\\$File/EPA+Presentation+to+Biogenic+Carbon+Emissions+Panel+March+25,+2015.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/2C793C16C629B8C185257E12006E5FE3/$File/EPA+Presentation+to+Biogenic+Carbon+Emissions+Panel+March+25,+2015.pdf)

⁸⁹ <http://www.epa.gov/climatechange/downloads/Biogenic-CO2-Emissions-Memo-111914.pdf>

derived and certain forest-derived industrial byproduct feedstocks, based on the conclusions supported by a variety of technical studies, including the revised Framework.

For other feedstock categories, the memo also suggests that:

- › *In addition, given the importance of sustainable land management in achieving the carbon reduction goals of the President's Climate Action Plan, the EPA expects that states' reliance specifically on sustainably-derived agricultural- and forest-derived feedstocks may also be an approvable element of their compliance plans. This approach is consistent with the EPA's recognition in the proposal that every state has different energy systems and available fuel mixes. Many states already recognize the importance of forests and other lands for climate resilience and mitigation, and have developed a variety of sustainable forestry and land use management policies and programs to address these concerns. Some states also encourage participation in sustainable forest management programs developed by third-party forestry and/or environmental entities.*

Upon its release the EPA tasked the SAB with evaluating the revised Framework, specifically providing further recommendations on the dynamic baseline approach (also referred to as a future anticipated baseline) and a calculation called the biogenic assessment factor (BAF) equation at the heart of the Framework, including terms representing different aspects of the biological and bioenergy carbon-cycles; growth/decay, harvest, processing, and combustion.

In April 2016, the SAB concluded its review. With five years of intensive review and debate notwithstanding, the SAB did not advance a suggested biogenic accounting framework to EPA for incorporation into its regulations. The SAB advised EPA to consider all changes in the landscape when biomass is harvested and not just counting emissions of GHGs at the emission source (i.e. smoke stacks). The timeline for when emissions are to be negated by new growth is the main point of continued debate. With some arguing that 100 years is an appropriate timeline and others focusing on the regulatory timeline of 2030 as being more appropriate. A 2030 timeline would disqualify most biomass feedstocks.

US Congress introduces legislation on biogenic emissions

In addition to the Framework process and administrative rulemaking of EPA, Congress is weighing in on the biomass emission accounting issue. In May 2015, a Bill titled S.1284, a bill to clarify the treatment of carbon emissions from forest biomass, and for other purposes, was introduced in the US Senate that would effectively go against the findings of the SAB.⁹⁰ This proposed legislation would require that the EPA:

- › *Assume that forest biomass emissions do not increase overall carbon accumulations in the atmosphere if, (1) a Forest Inventory and Analysis of the*

90 <https://www.congress.gov/bill/114th-congress/senate-bill/1284/text>

Department of Agriculture that is current at the time the action is taken shows that forest carbon stocks in the United States are stable or increasing; or (2) the forest biomass is derived from mill residuals, harvest residuals, or forest management activities.

Subsequently, in June 2015 the US House of Representatives proposed a new Bill, H.R. 2822, Department of the Interior, Environment, and Related Agencies Appropriations Act, 2016.⁹¹ A provision of this introduced legislation attempts to direct the EPA down a certain regulatory path, suggesting that:

- › *The Administrator of the Environmental Protection Agency shall base agency policies and actions regarding air emissions from forest biomass including, but not limited to, air emissions from facilities that combust forest biomass for energy, on the principle that forest biomass emissions do not increase overall carbon dioxide accumulations in the atmosphere when USDA Forest Inventory and Analysis data show that forest carbon stocks in the U.S. are stable or increasing on a national scale, or when forest biomass is derived from mill residuals, harvest residuals or forest management activities. Such policies and actions shall not pre-empt existing authorities of States to determine how to utilize biomass as a renewable energy source and shall not inhibit States' authority to apply the same policies to forest biomass as other renewable fuels in implementing Federal law.*

Then following the release of H.R. 2822 and S.1284, several leading members of the US Senate sent a letter⁹² to the Administrator of EPA, the Secretary of DOE, and the Secretary of USDA, three of the main federal government entities embroiled in the debate around the net GHG effects of bioenergy. The letter called for categorically defining certain types of biomass as carbon neutral, stating, “*There has been no dispute about the carbon neutrality of biomass derived from residuals of forest products manufacturing and agriculture....we urge you to ensure that federal policies are consistent and reflect the carbon neutrality of forest bioenergy.*” Similarly, some states that use significant quantities of bioenergy have begun to pass laws at the state level exempting biomass from certain GHG related permitting activities so long as the requirements of the federal Clean Air Act are met.⁹³

In response to this Congressional action, the Executive Office of the President, Office of Management and Budget (OMB) issued an official Statement of

91 <http://www.gpo.gov/fdsys/pkg/BILLS-114hr2822rh/pdf/BILLS-114hr2822rh.pdf> Such appropriations Bills are introduced in the US Congress periodically to provide funding to several large Federal agencies, such as the US EPA and US FWS. As part of the policy making process, both the US House of Representatives and the Senate produce legislative language, debate, and subsequently vote on any particular Bill. Eventually, both the House and Senate conference with each other around their versions of Bills that have passed their particular side of Congress, eventually leading to a package to be signed or vetoed (overturned) by the President, at which time a new law is established.

92 <http://www.wicker.senate.gov/public/cache/files/91f536af-0623-4ca0-b491-d02623914e86/biomass-letter-to-epa-usda-doe-6-30-15.pdf>

93 <https://olis.leg.state.or.us/liz/2015R1/Downloads/MeasureAnalysisDocument/28532>

Administration Policy⁹⁴ on June 23, 2015, strongly opposing H.R.2822, including the classification of forest biomass fuels as carbon neutral. Specifically, OMB's Statement suggests:

- › *The Administration objects to the bill's representation of forest biomass as categorically "carbon-neutral." This language conflicts with existing EPA policies on biogenic CO₂ and interferes with the position of States that do not apply the same policies to forest biomass as other renewable fuels like solar or wind. This language stands in contradiction to a wide-ranging consensus on policies and best available science from EPA's own independent Science Advisory Board, numerous technical studies, many States, and various other stakeholders.*

This is the strongest statement to date coming out of the Executive Branch of the Federal government regarding biogenic carbon accounting and came just before the release of EPA's Clean Power Plan. Most recently, in February 2016 the Senate introduced an amendment (S.A. 3140) to the [Energy Policy Modernization Act](#) of 2015 (S.2012) which if passed would legislatively define the neutrality of GHG emissions from bioenergy, so that any biomass feedstock an energy system could qualify for compliance with regulations for reducing GHG emissions, effectively circumnavigating the EPA biogenic accounting process.

EPA Clean Power Plan

In August 2015, the EPA released the final Clean Power Plan (CPP) rule.⁹⁵ This regulation establishes GHG emission standards for new power plants across the US and requires existing gas and coal power plants to reduce greenhouse gas emissions by 32% between 2022 and 2030 from a baseline year of 2005. The final rule is encountering significant legal challenges from several states and industries.

The legal precedent for the plan was established in 2007 when the US Supreme Court found that the EPA has the authority to regulate GHG emissions under the Federal Clean Air Act (Massachusetts v. EPA 549 U.S. 497). Following, the administration sought to establish a comprehensive regulatory framework to curb national GHG emissions. If implementation occurs as planned, the CPP will be the regulatory cornerstone of broader efforts to control US GHG emissions and the centrepiece of US commitments under the 2015 Paris Climate Agreement.

Section 111(d) of the Clean Air Act is the specific mechanism under which EPA is developing the CPP. As such, the CPP requires each of the 50 US states to regulate their power sector in a manner that reduces their emissions against a baseline measurement established by EPA. While the states are in the lead in devising compliance plans, the EPA maintains final approval authority. If EPA determines that state plans are insufficient or if states refuse to submit plans, the

94 https://www.whitehouse.gov/sites/default/files/omb/legislative/sap/114/saphr2822r_20150623.pdf

95 <http://www2.epa.gov/cleanpowerplan>

EPA will impose a Federal Implementation Plan⁹⁶. It is unclear how EPA will treat bioenergy under the Federal Implementation Plan.

States must submit their plans to EPA by 2022. States who wish to pursue, or are already pursuing, aggressive emission reduction programs beyond the CPP targets may continue to do so.

EPA has proposed four “building blocks” as guidelines for states to use to design their plans. The first two building blocks involve increasing efficiency at existing coal plants and shifting a larger proportion of the total generation away from base-load coal to currently underutilized natural gas power plants. This is expected to be the primary strategy in the first years of the CPP compliance period.

Building blocks three and four involve new investments in renewable energy and demand side efficiency, which can involve market-based mechanisms (e.g. cap and trade systems) within states or across regional power grids. Economic modelling by the US DOE forecast significant increases in renewable energy.

DOE projects that almost all of this renewable energy will occur as wind and solar, and bioenergy is not directly mentioned, although it is assumed to be included in the small amount of “other renewables.”⁹⁷ DOE’s projections suggest that natural gas fuel switching will occur rapidly; and while this shift is already underway, the rapid growth in natural gas infrastructure, such as expanded pipelines, will take time to develop.⁹⁸ In the interim, biomass co-firing may be viewed as a transition strategy, but the significance of this depends entirely on how the CPP factors in EPA’s carbon accounting framework.

Up to now, EPA has assumed that biomass co-fired at coal plants has a stack emissions rate of 0.08845 ton CO₂/MMBtu, not taking into direct account full life cycle accounting, primarily because EPA typically regulates emissions as measured at the stack. In its energy sector modelling via the Annual Energy Outlook reports, DOE Energy Information Administration (EIA) has always assumed the carbon neutrality of all biomass. Yet, when modelling CPP electricity production scenarios, EIA used EPA’s 0.08845 ton CO₂/MMBtu emissions rate to forecast whether biomass co-firing would occur as a result of CPP implementation (EIA, 2015). Under this assumption, EIA forecasts significantly reduced use of biomass in state compliance plans, where EIA has previously forecasted significant increases in bioenergy (co-firing) out to 2040 when assuming the carbon neutrality of all biomass feedstocks.

⁹⁶ The draft federal plan is out for comment now and is available here:

<http://www.epa.gov/airquality/cpp/cpp-proposed-federal-plan.pdf>

⁹⁷ <http://www.eia.gov/analysis/requests/powerplants/cleanplan/>

⁹⁸ As a component of the CPP, EPA’s New Source Performance rule for new, modified, or reconstructed power plants, mentions natural gas cofiring several times but biomass cofiring is not mentioned.

<http://www2.epa.gov/cleanpowerplan/carbon-pollution-standards-new-modified-andreconstructed-power-plants#rule-summary>

The use of bioenergy as compliance under the CPP

Under the final CPP rule, bioenergy is an allowable option for compliance under building block number three.⁹⁹ Under the CPP if states plan to use bioenergy as part of their compliance plans the burden of proof is placed on the states to prove to EPA that the use of biomass has net carbon reduction benefits. The Agency will handle such approvals of the use of biomass feedstocks within these plans on a case-by-case basis. This may entail the use of the biogenic accounting framework but no final decision has been made on this matter. In the months leading up to the release of the CPP two issues emerged regarding the use of biogenic feedstocks that will likely factor into EPA's approval process.

First, the consideration of exempting certain feedstocks thought to have low lifecycle GHG emissions. In the final CPP rule, EPA does not include exemptions for residues, even though previous communications by the agency through the McCabe memo indicated the benefits of using such feedstocks.

Second, prior to the release of the final CPP, the McCabe Memo communicated that EPA may allow states to use biomass feedstocks that were "sustainably harvested," but did not provide detail as to what was meant by this, or how it squared with EPA's own Framework and the scientific review of the SAB. In the final CPP rule EPA again communicated that "sustainability" will likely be relevant in the feedstock approval process, but does distinguish this from assumed "carbon neutrality."

The draft Federal Implementation Plan may offer some insight into how EPA is approaching the question of the "sustainability" of biomass feedstocks, stating:

- › *The EPA could also recognize biomass feedstocks from sustainably managed forests lands, provided that these feedstocks meet certain requirements such as demonstration that the feedstock is sourced from sustainably managed lands (for example, feedstocks from forest lands with sustainable practices like improved management to increase carbon sequestration benefits) and therefore helps control increases of CO₂ in the atmosphere.*

EPA also mentions elsewhere in the final CPP rule that if state compliance plans suggest the use of biogenic feedstocks they:

- › *Must include appropriate consideration of feedstock characteristics and climate benefits. Specifically, the use of some kinds of biomass has the potential to offer a wide range of environmental benefits, including carbon benefits. However, these benefits can only be realized if biomass feedstocks are sourced responsibly and attributes of the carbon cycle related to the biomass feedstock are taken into account.*

EPA's approval of state compliance plans proposing to use biomass feedstocks will involve EPA defining categories of "qualified biomass." The CPP rule already signals that not all biomass will be considered qualified:

⁹⁹ <http://www.epa.gov/airquality/cpp/cpp-final-rule.pdf>, page 426

- › *Not all forms of biomass are expected to be approvable as qualified biomass (i.e., biomass that can be considered as an approach for controlling increases of CO₂ levels in the atmosphere)....State plan submissions must describe the types of biomass that are being proposed for use under the state plan and how those proposed feedstocks or feedstock categories should be considered as 'qualified biomass' (i.e., a biomass feedstock that is demonstrated as a method to control increases of CO₂ levels in the atmosphere). The submission must also address the proposed valuation of biogenic CO₂ emissions (i.e., the proposed portion of biogenic CO₂ emissions from use of the biomass feedstock that would not be counted when demonstrating compliance with an emission standard, or when demonstrating achievement of the CO₂ emission performance rates or a state rate-based or mass-based CO₂ emission goal).*

While not directly exempting residuals within the CPP itself, EPA does provide language with regards to the likely approval of such feedstocks as qualified biomass, "*when proposed with measures that meet the biomass monitoring, reporting and verification requirements discussed below and other measures as required elsewhere in these emission guidelines.*"

As defined in the CPP rule, the monitoring and reporting requirements in the use of qualified feedstocks are left up to the states define. This may be another area in which the EPA biogenic accounting framework is used to provide guidance to states. Moreover, state monitoring and reporting programs must "*identify specific tracking and auditing approaches for qualified biomass feedstocks.... In the case of sustainably-derived forest- and agriculture-derived feedstocks, this will also include measures for verifying feedstock type, origin and associated sustainability practices.*" These tracking procedures must be able to prove to EPA that planned biogenic CO₂ emissions reductions via the use of qualified biomass are "*quantifiable, verifiable, non-duplicative, permanent and enforceable.*"

6 Environmental implications of increased biomass production

Global projections for wood bioenergy growth based on IPCC emission reduction scenarios suggest more than a doubling of global wood demand could result under high deployment bioenergy scenarios (Buongiorno et al., 2012; WWF, 2011; Berndes et al., 2003).¹⁰⁰ In the US, this same conclusion has been reached in regards to the potential combined effect of the existing federal biofuels mandate and a previously proposed national renewable electricity portfolio goal (25% by 2025), corresponding to a significant drawdown of forest carbon stocks in the short-term, representing considerable emissions (Sample, 2013).¹⁰¹ This section evaluates commonly perceived environmental effects attributed to expanding demand for wood biomass (pellets) from the Southeast US.

In addition to the widely reported and varied concerns related to loss of biodiversity and forest carbon stocks (discussed in detail below), the forestry sector cites several positive environmental effects of expanded markets for forest biomass. For instance, the creation of markets for small diameter trees and/or trees of low commercial value, which can provide a mechanism to achieve a variety of forest management objectives which in turn can result in public benefits, e.g. wildfire risk mitigation, forest health improvement, watershed improvements, wildlife habitat improvement (increasing forest landscape heterogeneity), timber stand improvement, aesthetics, etc. Another commonly stated contention of the forestry sector, which is perhaps yet to be proven in its universality, is that biomass markets help balance harvests and reduce high-grading by adding value to low-value segments of harvests.

¹⁰⁰ Under IPCC scenario A1B global roundwood demand increased by over five times current level (Buongiorno et al., 2012).

¹⁰¹ Note that while a nation renewable portfolio goal does not exist, 32 states have such policies, although few exist in the southeast, a region in with significant coal-fired power generation. As discussed in chapter 1, if forest-derived biomass fuels are recognized as having carbon benefits under the US EPA's regulatory framework, significant increases in biomass consumption in the US south could result.

Common claims about current and forecasted levels of demand and industry sourcing practices are considered. This critique focuses on the effects of increasing demand for wood biomass, principally related to increased harvest activities, changes in land use and land cover (forest type conversion), and their concomitant effects on biodiversity and the effects on the net carbon emissions. The commonly perceived environmental implications identified here are consistent with those identified in other recent sustainability benchmark analyses focused on these specific issues (see Sikkema et al., 2014).

Wood fibre markets are the dominant force shaping southern forests, as evidenced by a recent global forest cover change analysis (Hansen et al., 2013; see Figure 31), which found that disturbance rates of forests in the Southeast US were four times that of South American rainforests during the study period, with more than 31% of Southeast US forest cover showing disturbance and/or subsequent regrowth from 2000 – 2013. The vast majority of disturbance in this timespan was timber harvests and regeneration (Hansen et al., 2013).

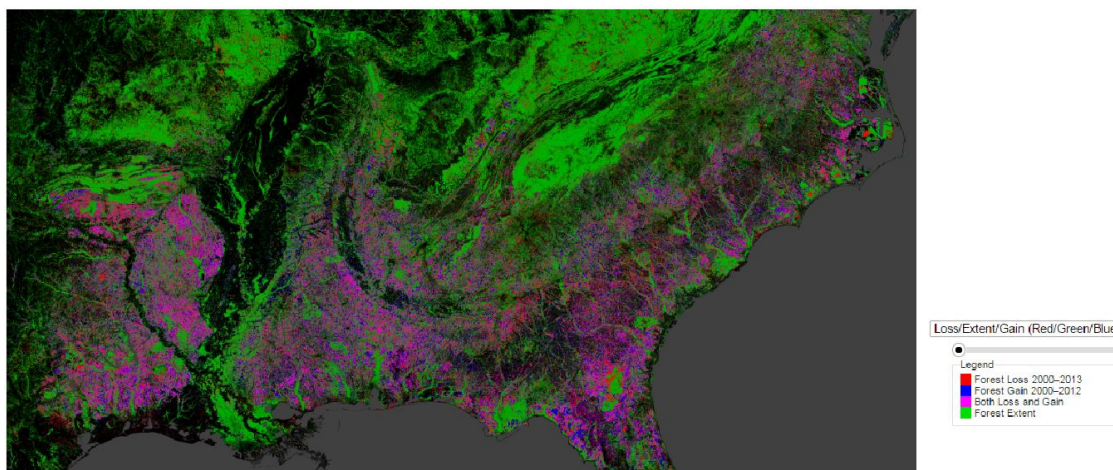


Figure 31. Extent of forest cover loss (red), gain (blue), and areas with forest loss and gain (purple) in the southeast US (2000 – 2013). Source: Hansen et al. 2013. ¹⁰²

As a driver of change in the forest land-base, inquiry into the environmental effects of EU reliance on wood pellets from the Southeast US must consider the potential effects, which increasing market demands could have on the integrity of environmental conditions (water quality, biodiversity, carbon sinks and net GHG flux of forest ecosystems).

Timber markets and alternative land uses

Forest loss is a significant concern for the region (Wear & Greis, 2013). Forest carbon stock losses to urban/suburban development are considered permanent. In the Southeast US, much of the argument supporting forest bioenergy is the assumption that strong timber markets beget investments in forests and eventually

¹⁰² This map was produced using satellite imagery to detect changes in forest cover. This does not necessarily equate to a change in land use, but is related to a change in carbon stocks. Lands that were cut and replanted between 2000 and 2013 likely have lower timber and carbon stocks than lands not cut during this period

more forestland. Specifically, that strong timber markets bolster the ability of forests to compete with agriculture and development (Miner et al., 2014; Zhang et al., 2015; Wear & Greis, 2013).

Based on historical observations of landowner behaviour, regional land-use projections conclude that strong timber demand have also resulted in tree plantings and plantation area, which is expected to grow at the expense of natural forests. Conversely, Galik & Abt (2015) project that under increasing bioenergy market demand, the area of all forest types (including naturally regenerated pine and wetland forests) could expand.

In the US, land-use conversion is a function of the economics of alternative uses, food and fibre markets, population growth, land use regulations,¹⁰³ and individual decisions made by millions of landowners. While risk of complete deforestation on a regional scale is extremely low, forest conversion to other uses persists, especially when sawtimber prices are low and forestland rents decrease. Increasing rents for agricultural land are expected to enjoy continued growth in the Southeast. Moreover, in some areas, population pressures are increasing and comparative values for agriculture and forests cannot compete.

From a base year of 1997 through 2060, the USDA Forest Service forecasts a loss of 4.5 – 9.3 million hectares (11 - 23 million forested acres) in the region (Wear & Greis, 2013). The US Geological Survey (USGS), has modelled future land scenarios based on IPCC land use and land cover (LULC) accounting protocols, concluding that urban development increases in the Southeast in all future scenarios (Sohl et al., 2014). The USGS finds that forest loss could amount to nearly 4 million hectares (10 million acres) by 2050. The USGS projection is in line with a USDA Forest Service scenario of (4.5 million hectares (11 million acres) lost by 2050, although this is a low-end projection for the Forest Service (Zhao et al., 2013).

As forests at the edge of developing areas are converted, up to 90% of local species are put at risk, as are other ecosystem services not the least of which is carbon storage (Stein et al., 2005). Unlike forest type conversion and conversion to agriculture, forest to urban land-use change is considered more or less permanent. As population density increases, additional challenges beyond outright forest loss also increase, such as fragmentation and parcelization (Samson & Decoster, 2000).¹⁰⁴

¹⁰³ Local (State-, County-, or municipal-level) land use laws in the Southeast do not often prohibit unfettered low-density development.

¹⁰⁴ Parcelization is considered the act of dividing forest land into two or more ownerships, is a related by separate concept to fragmentation, where by forest coverage is physically divided into smaller units. Land use laws in the southeast are generally permissive of these actions.

6.1 Effect 1: Forest type conversion from natural forests to plantations

Commonly raised question(s):

Forest type conversion from natural forests to plantations has been extensive; does increasing bioenergy demand pose additional risks of forest type conversion? Do increasing markets for bioenergy intensify removals in a manner that facilitates forest conversion?

The composition of forests in the region has changed greatly in the last half century. Forest type conversion poses risks to biodiversity, as natural or semi-natural forests generally hold a greater array of habitats and species than intensively managed pine plantations. Forest type conversion may also lead to loss of carbon.

Private property rights in the US are such that landowners can harvest timber in accordance with applicable laws and freely sell and/or convert forestland to other land uses such as urban development and agriculture. Natural forests can also be converted to plantations provided that rules for protecting threatened and endangered species are followed. In their study of the expanding bioenergy sector and associated biodiversity risks, Evans et al. (2013a) identify forest conversion as among the largest risks in the Southeast US.

The connection between softwood fibre markets and landowner preference for planted pine is well documented, *“Forest landowners have shown a strong propensity to convert naturally regenerated forests to planted pines after harvesting, especially in the Coastal Plain, an investment response that is strongly linked to the condition of forest product markets,”* with sawtimber markets driving such activity (Wear & Greis, 2013). Ultimately, the significance of the association of new bioenergy demand to plantation expansion depends on whether this increased demand induces new investment in converting natural forests to planted pine.

A brief history of forest type conversion in the South

Conversion of natural forests to pine plantations has been extensive in all regions of the Southeast. From 1950 to 2000, the area of pine plantations grew from 728,434 hectares (1.8 million acres) to 13 million hectares (32 million acres), to around 16 million hectares (40 million acres) in 2013 (Fox et al., 2007; Wear & Greis, 2013). Plantation expansion can happen quickly if market conditions are ripe. In just 20 years, between 1990 and 2010, the amount of pine plantations doubled from 8 million hectares to 16 million hectares (20 million acres to 40 million acres). In Georgia and Alabama for instance the increase in plantation acres from 1972 to 2013 was 130% and 300% respectively (Hartsell, 2013; Brandeis, 2015).

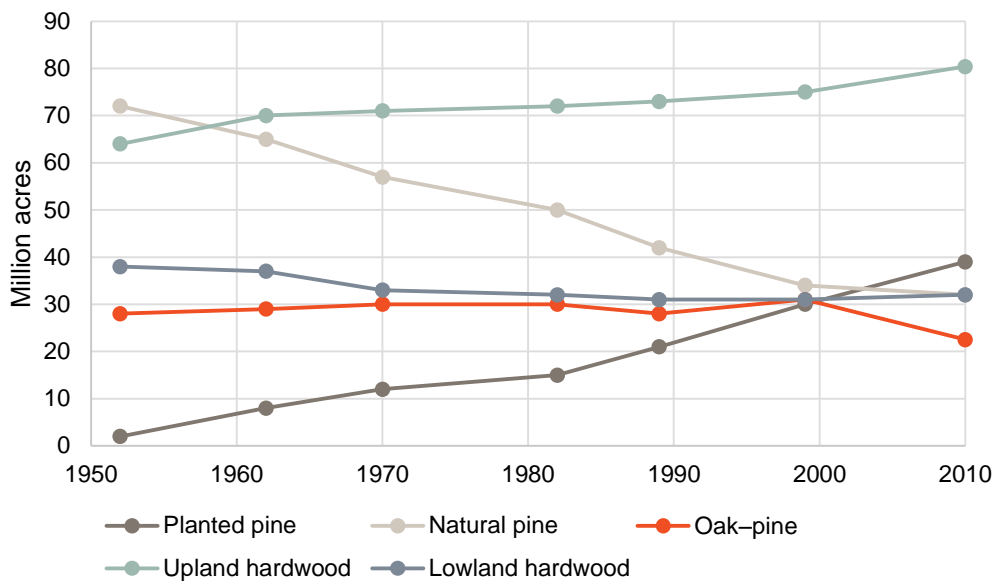


Figure 32. Change in area of southern forest types (1950 – 2010). Source: Wear & Greis, 2013.

In addition to converting marginal agricultural land, this prodigious growth in planted pine largely came at the expense of natural pine, including ecologically exceptional longleaf and shortleaf pine habitats. Forested wetlands were also converted to pine plantations via hydrologic modification. Upland hardwoods were not immune either. For instance, a multi-decadal (1981 – 2000) study of forest type conversion within a 243,000 hectare region of the Cumberland Plateau¹⁰⁵ found that natural forests declined by 14% (26,592 hectares) with 74% of this loss resulting from conversion of natural hardwood stands to loblolly pine plantations (McGrath, 2004).

Projections of future plantation expansion

The Southern Forest Futures Project suggests that bioenergy is expected to be the single largest source of new demand and that this will contribute to the expansion of pine plantations converting both agricultural land and natural forests. Over the next 45 years, this demand could contribute to a 2.8-11 million hectare (7-27 million acres) increase in plantations, with the loss of natural pine and hardwood forests being likely (Wear & Greis, 2013).

Using the SRTS model to forecast the effects of the level of demand specified by Forisk, Abt et al. (2014) found that recent trends in increasing prices for pellet feedstocks would likely continue over the next decade with net price increases for non-sawtimber pine rising by 93 – 140% compared to 2010 levels by 2025. Correspondingly, hardwood prices are projected to increase by 23 – 39% by 2025 to increase hardwood harvesting across the southeast, in some areas more than others.

Accompanying these market effects, out to 2025, Abt et al. (2014) project that the area of natural forest in the Coastal Plain decreases by about 2 million hectares (5

¹⁰⁵ This region is known for its exceptional biodiversity value.

million acres) with plantation acreage expanding by adding about 2.4 million hectares (6 million acres) of new pine to the Coastal Plain. The modelling finds that over the longer-term while harvesting of pine across the south will increase in response to prices, net growth also increases as landowners invest in new pine plantings.

One concern often raised in opposition to such modelling is that relying on observations of the historical behaviour of landowners is not an accurate predictor of future behaviour because markets have changed significantly. For instance, many pine plantations now being harvested were planted in the early 1990s by vertically integrated forest product companies, who owned and controlled the entire production chain from the land-base to the paper machine. This corporate structure, which no longer exists, encouraged investment in plantations because they were integral to their production process.

Likewise, there is uncertainty in competing demands for land. In addition to a regional population boom, which will push for more development, agricultural commodity prices have recently surged 75% in just a two-year period (2005 – 2007). This increase was in part driven by a new national biofuels policy (Hausman et al., 2012). This resulted in about 80,128 hectares (198,000 acres) of forest being replaced by cropland between 2008 and 2012 (Lark et al., 2015). It is largely unknown how planted pine in restructuring fibre markets will fair against high agricultural commodity prices. If high pulpwood prices persist as forecasted, one potential result could be less agricultural land being converted to pine and an uptick in the amount of natural forest being harvested and subsequently converted to planted pine to meet growing demands, as well as more intensive management of existing plantations to accelerate productivity.

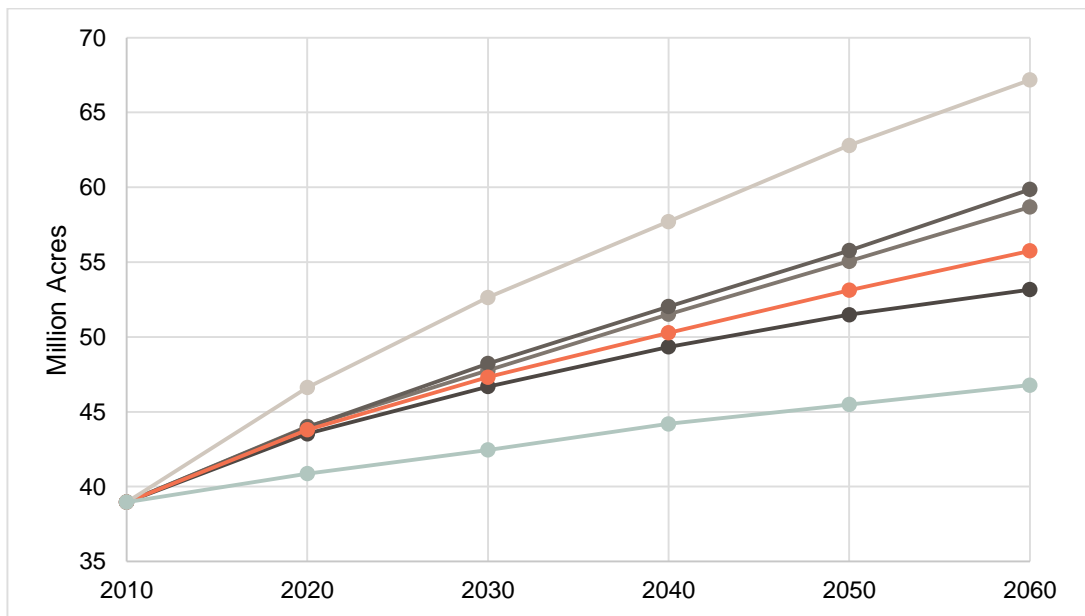


Figure 33 Southern Forest Futures Project scenario forecasts of plantation pine area expansion. Source: Wear, 2012.

Decisions of NIPF owners will play an important role in determining future land cover. In Alabama, it was found that landowners who were not currently actively managing their forests were more likely to report a willingness to harvest biomass than those who were currently investing in forest management (Paula et al., 2011). In Alabama and Mississippi, most NIPF owners preferred whole-tree in-woods chipping, including the systematic removal of logging residues (Paula et al., 2011; Grunchy et al., 2012). This is often due to the fact that such removals help reduce costs of site preparation for establishing a pine stand. Harvesting of additional amounts of non-sawtimber Roundwood and logging residues can add value to sawtimber harvests making them incrementally more cost-effective. From a landowner perspective this could be a good thing as it can help facilitate management goals, for instance conversion of degraded forest stands to pine. This can however also yield negative habitat outcomes.

One account from the Panhandle of Florida, an area important for its high biodiversity, suggested that a contractor: *“is a major supplier of Green Circle’s plant, delivering over 100,000 tons of microchips each year. [The contractor] collects most of the wood within a 60-mile radius of the plant, typically clearing previously unmerchantable wood for landowners who want to replant or clear their land. ‘I put up a sign on a cutting job near here saying we were clearing land for biomass....We had landowners coming over to tell us they had a 50- or 60- acre tract for us to clear. A two-week job quickly became a four-month job. We ended up cutting about 600 acres”* (Wood Bioenergy, 2013). As quoted, the contractor suggests that landowners would *replant or clear their land*, which suggested that demand from the pellet mill helped convert lands to another use. Moreover, natural regeneration without proactive replanting is a much more common regeneration tactic. Few states in the South have laws requiring restocking forests following harvest.

The forest and bioenergy certification systems address forest conversion in different ways. Evidence from a Green Gold Label audit suggested that part of the sourced forest area in the southeast was converted to agricultural purposes after being cut in 2011. Specifically, Sikkema et al. (2014) found that, *“the larger landowners actively replanted the area, but the smaller ones relied on natural regeneration. Due to their low wood revenues, a small (insignificant) part of these forests is nowadays converted to agriculture.”* As discussed in this section, forest type conversion has been ongoing and is expected to occur independent of bioenergy, but additional demand from energy markets will contribute, although it is impossible to know at what level.

Key conclusions for effect 1:

- › Over the last 50 years, demand for fibre has contributed to a very significant increase in the area of plantation pine coinciding with a loss of natural forests.
- › There are no laws that limit the conversion of natural forests to plantations. Certification systems address this issue differently, with varying levels of success.

- › Forest landowners have shown a strong propensity to convert naturally regenerated forests to planted pines after harvesting, especially in the Coastal Plain.
- › While actively debated, there appears to be a lack of recent empirical data regarding the role increasing demand from pellets may play in either reducing conversion pressure (incentivizing reinvestment in forests) or helping to facilitate conversion (making land clearing more cost-effective).
- › Plantation area in the South can expand rapidly in response to markets. Between 1990 and 2010, the amount of pine plantations doubled from 8 million hectares to 16 million hectares.
- › Bioenergy is expected to be the single largest source of new wood demand and this is anticipated to contribute to expansion of pine plantations at the expense of both agricultural land and natural forests of higher biodiversity value.
- › Modelling projections suggest that pine plantation area expansion could lead to more carbon being stored on the landscape in the long run in pine plantations, but less in hardwood forests. However, this shift would come at the expense of natural forests and biodiversity values.
- › In recent years, agricultural commodity prices have grown rapidly resulting in more than 80,000 hectares of forest in the US being replaced by cropland from 2008 – 2012. If high pulpwood prices increase as forecasted and high agricultural commodities persist, one potential result could be less agricultural land being converted to pine and an uptick in the amount of natural forest lost to plantations upon harvest.

6.2 Effect 2: Intensification of management and harvesting

Commonly raised question(s):

Intensification of forest management practices and harvesting driven by increased demand presents potential risks to site productivity and site-level biodiversity, but may offer potential wildlife habitat benefits in some settings.

As it was shown in earlier sections, industrial (sawmill) residues make up a significant part of the industrial pellet raw material. However, it was also shown that if these were not used for pellets, they would be generally utilised by other industries. If they are taken for pellets, those other uses would need to be covered from extra timber production, most likely pulpwood. Therefore, it is reasonable to

assume that the increased demand for industrial pellets requires a roughly equivalent increase in logging removals in the region.

Intensification of biomass removal has three main dimensions: (i) increase of the amount of biomass removed per unit harvested area (e.g. whole-tree harvests); (ii) increases in thinnings and related silvicultural actions, and (iii) increasing the area of final harvest.

Linked to the above, there is an increased intensity of related activities. Industrial plantation management often involves intensive site preparation, specifically piling of logging residues, disking, bedding, herbicide use, and planting of selectively bred trees (Fox et al., 2007; Dwivedi et al., 2011). Such activities may be followed by mid-rotation thinning and fertilization, altogether increasing plantation productivity to a point where loblolly pine plantations routinely produce three times as much wood as naturally regenerated pine (North Carolina Forestry Service, 2012; Fox et al., 2007).

The goal of intensive management is to maximize profits. The prospects for a sizable expansion of pine plantations at the expense of natural forests pose potential site- and landscape-level impacts to wildlife habitat and biodiversity (Evans et al., 2013b). At the site-level, plantations are characterized by comparably low amounts of legacy features (i.e. snags or coarse woody debris on the forest floor). Conversely, in natural pine forests, coarse woody debris remains an important structural component, with one study of southern loblolly pine forests finding that breeding bird abundance declined by nearly 50% with the absence of coarse woody debris (Lohr et al., 2002), as occurs in clear-cut forests with harvesting systems with high rates of logging debris removal (e.g. whole-tree harvesting).

A meta-analysis of 26 biomass-harvesting studies found that diversity of birds was substantially and consistently lower in harvested areas where coarse woody debris had been removed as a component of harvesting logging residues via whole-tree removal (Riffell et al., 2011).

Intensification of harvesting (whole tree harvest)

The intensity of harvesting, as measured by the amount of material removed, has been shown to increase in response to biomass markets (Abbas et al., 2011; Fritsche et al., 2014; Janowiak & Webster, 2010; Scott & Dean, 2006; Sikkema, 2014; Thiffault et al. 2011).¹⁰⁶ In the Southeast US, whole-tree harvesting has been practiced for quite some time.

In general, wood pellets do not utilize large quantities of logging residuals as a main feedstock preferring clean feedstocks with low risk of soil and other contaminants that can occur with utilizing logging residues. However, in areas where pellet demand occurs alongside local wood energy demand (for industrial

¹⁰⁶ Appendix E offers a tabular comparison of various intensities of harvest on stand-level ecological attributes.

process heat and electric power) whole-tree in-woods chipping is a fairly common occurrence and is related to multiple markets for whole-tree chips (mulch, energy, etc.) and to land clearing.

Harvesting a greater percentage of stand components than is done using stem-only harvesting, can also affect soil biophysical conditions with consequences to plant communities. Greater removal of wood biomass for bioenergy raises concerns about whether adequate levels of nutrients (e.g. calcium, magnesium, and potassium) can be maintained to protect site productivity (Janowiak & Webster, 2010). Many tree components that comprise a small amount of biomass, such as leaves, cambium, and root tips, contain a proportionately large quantity of nutrients when compared with tree wood (Hakkila, 2002; Powers et al., 2005). Models of forest nutrient budgets suggest that intensive whole-tree harvesting can cause long-term productivity declines (e.g., Boyle et al., 1973; Pare et al., 2002). In the US East in particular, calcium is the most likely nutrient to become depleted in the long term (Boyle et al., 1973; Mann et al., 1988, Federer et al., 1989). However, a review of research investigating stem-only and whole-tree harvesting systems by Janowiak & Webster (2010) found few long-term impacts on soil nutrients or future biomass production under more intensive management.

Goerndt et al. (2014) indicate that soils that are most likely vulnerable to nutrient depletion associated with woody biomass harvesting are those formed from highly-weathered parent or quartz-rich parent materials. Soils formed in these parent materials generally have a low cation-exchange capacity, which limits their ability to store nutrients and supply nutrients. These kinds of parent materials also contain few primary minerals capable of resupplying nutrients such as calcium, magnesium, or potassium when they weather. Sustaining site productivity in these kinds of soils requires restricting the amount of biomass removed during a harvest or maintaining longer rotations to allow for nutrient recovery (Wisconsin Department of Natural Resources, 2008).

Research continues to assess the long-term potential impacts to forest productivity of intensive removal of nutrients and organic inputs to soils via intensive whole-tree harvests. So far, the evidence of impacts is mixed (Vance et al., 2014). For instance, in a meta-analysis covering 53 temperate and boreal forests Thiffault et al. (2011) conclude that there are “*no consistent, unequivocal and universal effects of forest biomass harvesting on soil productivity.*” Likewise, data collected over the first decade of the USDA Forest Service Long Term Soil Productivity study of 26 sites across the US indicate that the removal of logging residuals during sawtimber harvests had no detectable influence on forest growth within the first 10 years after harvest (Powers et al., 2005). On the other hand, another long-term study found an average productivity reduction of 18% in loblolly pine plantations following whole tree harvesting in-woods chipping operations (Scott & Dean, 2006).

Soils with surface horizons containing soil particles that are strongly aggregated, especially those with strong granular structure, are less vulnerable to erosion. Minimizing the equipment traffic during biomass harvest operations reduces the disturbance to the protective forest floor and helps maintain strongly aggregated soils. However, the strength of soil aggregates is largely influenced by the texture and organic matter content of the surface horizon, thus very site specific. Soil

organic matter serves as a binding agent that aids in the formation of strong soil aggregates. However, because their size and nature silt particles tend not to aggregate as strongly as clay particles. Soils with high silt content and low organic matter content tend not be strongly aggregated and are more vulnerable to erosion. To reduce erosion risk it may be necessary to restrict biomass harvesting operations on soils having both low organic matter and high silt content (Evans et al. 2012).

As suggested by Janowiak & Webster (2010) and Goerndt et al. (2014) continued monitoring and research is required given possible individual and combined effects from woody biomass harvesting practices and atmospheric deposition on forest nutrients and site productivity (Adams et al., 2000, McLaughlin & Phillips, 2006). In addition, more information is needed to evaluate the effects of management activities that will be altered as a result of increased biomass use, such as changes in rotation length or seasonality of harvest (Janowiak & Webster, 2010).

Increase in thinnings

Thinnings can provide considerable amounts of biomass, in particular pulpwood and logging residues. A meta-analysis of 33 studies investigating the effects of forest thinning on biodiversity concluded that thinning had either neutral or positive effects on biodiversity (Verschuyl, 2011).

In the Southeast, thinnings are practised in pine plantations, but seldom in hardwood forests. Indeed biomass markets do support thinning of pine plantations, which can improve habitat values and overall productivity at these sites.

It is unclear to what extent export pellet supply comes from increased thinnings. With an increasingly tight market for pine pulpwood, thinning rates would probably already be rather high in professionally managed plantations, but the extra demand probably increases interest in thinnings elsewhere, in particular plantations of NIPFs, bringing extra supply to the market.

Increased final harvest area

Raw material demand not met from the higher rate of biomass removal in harvest areas or increased thinnings is likely to be supplied from increased final harvest, typically clearcuts. Assuming that half of the EU import demand projected for 2025 were satisfied from the above sources, satisfying the remaining half would require the total growing stock (all roundwood harvested) from around 90,000 hectares of average Southeast forest annually, or the net-annual growth from 2.13 million hectares. This would put an additional pressure on an already dynamic forest landscape.

Key conclusions for effect 2:

- › Increased demand will result in increased harvesting activity, both in terms of intensity and area of removals.

- › Research continues to assess the long-term potential impacts to forest productivity of intensive removal of organic inputs to soils via intensive whole-tree harvests. So far, the evidence of impacts is mixed.
- › More information is needed to evaluate the effects of management activities that will be altered as a result of increased biomass demand such as changes in tree rotation length.
- › Thus far, logging residues are not a significant feedstock for industrial wood pellets, and as such, possible impacts related to intensification of residue removals are quite small
- › It is unclear to what extent extra thinnings contribute to the raw material supply of pellets.
- › The extra raw material demand not met from residues and thinnings requires increasing the harvest area, with a considerable amount of additional clearcuts projected annually.

6.3 Effect 3: Increased pressure on forests of high biodiversity value

Commonly raised question(s):

Are growing demands placing increasing pressure on areas of particularly high biodiversity, for instance, bottomland hardwoods and natural pine in the Coastal Plain?

In spite of regulations such as the ESA, direct impacts to forests harbouring rare, threatened, and endangered species do occur. Given the prevalence of private working forests and that the Southeast has the least amount of protected habitat (public and private lands under conservation easements or otherwise managed for conservation) of any region in the US, the risk of impacting species of conservation concern is real, and exacerbated if precautions are not taken.

There are a number of species of concern in the region for which populations are in decline. This should matter to the forest industry in that if a listing of those species is warranted under the ESA it could negatively affect the economic objectives of the forestry sector. Therefore, the ongoing conservation of these species and their habitats should be a priority for economic if not other reasons.

Land-use change is the main driver of habitat loss in the region. This slices both ways for the forestry sector. Forest product markets can help keep land forested, something that is good for habitats, but it comes at the cost of increased logging activity (disturbance) and can also contribute to conversion of natural forests to plantations, something which has contributed to habitat loss and species decline.

As discussed in effects 1 and 2, forecasted demands could lead to millions of additional hectares of natural forests in the Coastal Plain being harvested, possibly followed by expanding plantations and other conversion, such as urban development. As such, additional pulpwood demands attributable to industrial pellets, in addition to domestic bioenergy, is likely to result in additional pressure on high-biodiversity forests, such as those habitats described in section 2, longleaf pine and bottomland hardwoods, for instance. As hardwood forests of the region are seldom thinned, the demand for hardwood pulpwood is likely to be met predominantly from additional harvesting, likely to be clear-cuts.

Identifying areas of biodiversity at risk to be negatively impacted by energy demand

A challenge with identifying areas of “high biodiversity” is that multiple classification systems exist, generating a plethora of priority area maps. For instance, FSC’s preliminary national risk assessment identifies certain areas in the southeast as High Conservation Value forests. Similarly, Georgia-Pacific a major forest products company has identified 2.2 million hectares (5.5 million acres) across their southern supply chain where locations of known concentrations of rare and endangered species are known to exist, where intact and rare forest landscapes persist, and where concentrations of species-rich forest exist. The goal being to remove these forests from their supply chain and control risks to their company, reputational or otherwise. Enviva recently announced a movement toward a similar approach in the Coastal Plain of North Carolina, proclaiming certain forested wetlands as now being removed from their supply chain for certain pellet mills.

NGOs are presently completing similar mapping exercises that show the overlay of biodiversity within facility sourcing areas but do not explicitly link this to sourcing strategies of wood users. For instance, the Audubon Society has produced maps displaying how the procurement areas of operational and proposed pellet plants intersect with important bird areas (IBAs) and priority forest blocks currently being evaluated by Audubon as potential IBAs for their value as habitat for forest interior dwelling species (see Figure 34).¹⁰⁷

¹⁰⁷ The IBA program is part of an international effort administered by Bird Life International. In the US, the National Audubon Society is the partner organization identifying and monitoring IBAs. More information is available here:

<http://www.birdlife.org/americas/programmes/important-bird-and-biodiversity-areas-ibas-americas>.

Information on specific IBAs: <http://netapp.audubon.org/iba>

Criteria used to designate IBAs:

<http://web4.audubon.org/bird/iba/prioritizedibas.html>.

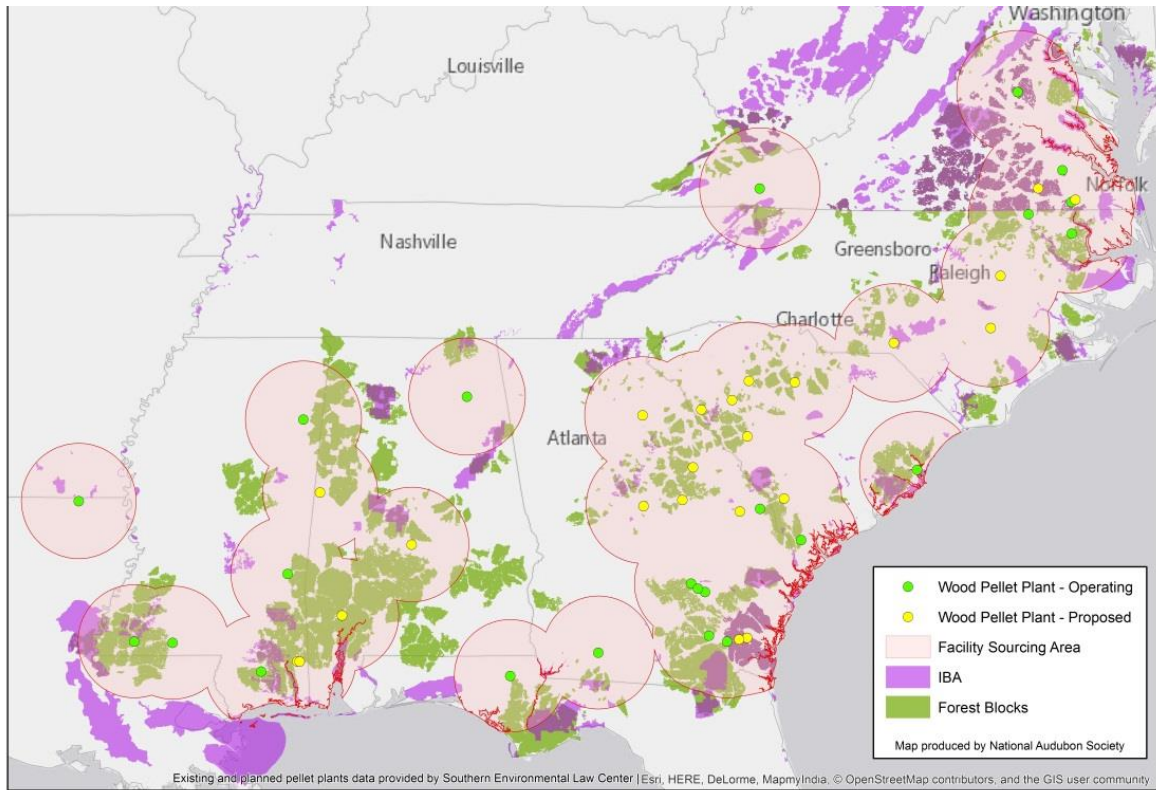


Figure 34. Important Bird Areas and Priority Forest Blocks within the sourcing areas of existing and proposed wood pellet plants in the southern US. Source: National Audubon Society, 2015.

Only about 36% of the IBAs across the south are currently considered “protected,” (having at least 50% of the land area within the IBA under some type of permanent protection). By this definition, none of the IBAs occurring within the procurement zones of existing and proposed pellet plants are considered to be protected. This does not mean, however, that actions cannot be taken to minimize the possibility of negative effects of forest management activities within these areas.

Table 6-1. Number of IBAs and their protected status, within 75 miles of pellet plants >100,000 tons per year. Source: National Audubon Society, 2015.

| Number of IBAs in procurement areas | State | Total size of IBAs (hectares) | Percentage of IBAs that are protected | Number of operational or proposed pellet plants with procurement areas that overlap IBAs |
|-------------------------------------|----------------|-------------------------------|---------------------------------------|------------------------------------------------------------------------------------------|
| 4 | Alabama | 225,840 | 27% | 4 plants proposed |
| 2 | Arkansas | 3,040 | 25% | 1 operating |
| 2 | Florida | 43,780 | 0% | 1 operating |
| 2 | Georgia | 1,127 | 4% | 3 operating, 1 proposed |
| 1 | Louisiana | 382,471 | 25% | 1 operating |
| 3 | Mississippi | 3,035 | 5% | 1 operating |
| 10 | North Carolina | 411,728 | 16% | 2 operating, 3 proposed |
| 7 | South Carolina | 26,254 | 10% | 3 operating, 2 proposed. |
| 1 | Tennessee | 20,327 | 46% | 1 operating |
| 7 | Virginia | 629,068 | 9% | 4 operating |

At least one recent analysis considered what the market response to new biomass demand would be with supply limiting “no go” areas (See Figure 35, Galik & Abt, 2015) being imposed as a proxy for sustainability criteria.

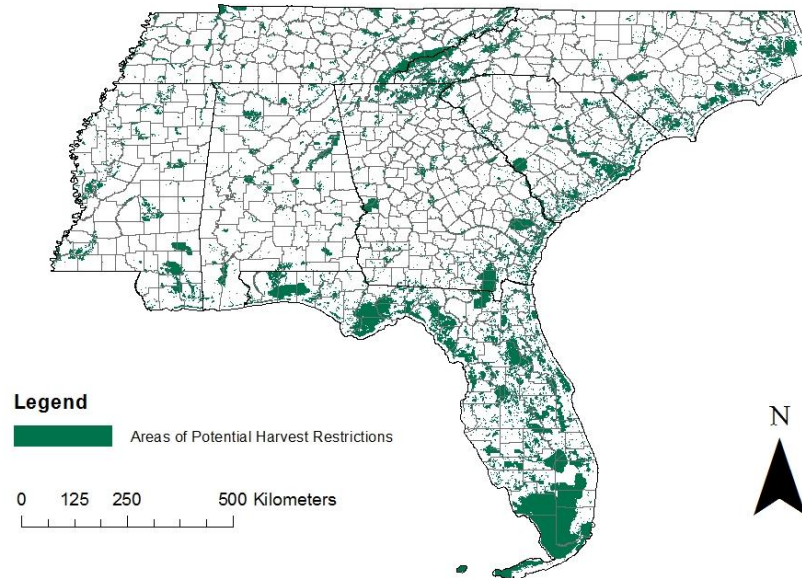


Figure 35. Areas of potential harvest restrictions as determined by Galik & Abt (2015). Includes protected areas, areas identified as having special conservation significance in the USGS GAP database, private lands covered by conservation easements, or areas classified as wetlands or other water bodies. Source: Galik & Abt, 2015.

Assuming additional demand of around 12.2 million green tonnes coming from the South’s export pellet mills (controlling for demand from other industries), Galik & Abt conclude that in both a “no go” scenario and a counter-factual scenario without such restrictions; harvesting increases, forest inventories change very little over the long-term, forest area increases, and the area of plantations increases. That all forest types expand based on this modelling is counterintuitive and mostly not explained by the authors. Under this demand scenario, carbon gains and loss fluctuate over the ~30-year time series (2010 – 2040), resulting in a net gain of 60 million tons of forest carbon stock over the baseline. Pulpwood prices increase by about 50% but this remains within the range of historic variation, versus the very large price increases that are forecasted under Abt et al. (2014) and Alavalapati et al. (2013) which model the effects of larger demand increases.

The 12.2 million green tonnes of demand considered by Galik & Abt (2015) isolates demand from pellet mills alone and does not consider the effects of future aggregate increases in demand from pellets mills, non-pellet bioenergy, and other wood uses. While this may be a reasonable approach at present since demands for domestic forms of bioenergy are low, it does not reflect possible scenarios for additional biomass demand that could result from possible expansion in co-firing in response to the Clean Power Plan.

Galik & Abt's results suggest that placing restrictions on where biomass is sourced steers production away from sensitive areas concentrating it in other areas of the landscape. Plantation expansion is foreseen, but not to the degree that is forecasted in Abt et al. (2014), which indicates the sensitivity of the landscape to various levels of additional pulpwood demand.

Ecological risks involved with hardwoods

Hardwood trees make up about half of the forests in the South, but these trees are not evenly distributed. Abt et al. (2014) found that forecasted demand for domestic and export bioenergy markets in the Southeast US could increase hardwood harvesting, notably in the Coastal Plain, but that hardwood removals would likely not offset regional growth. Results from the exploratory analysis in chapter 7 also suggest increased removals in areas of the Coastal Plain.

Therefore it is more difficult to forecast possible land use and management changes associated with rising timber prices in hardwoods other than stating that increases in harvesting is expected. Past observations of periods of increasing hardwood harvests do indicate some conversion to pine plantations. These broad-scale results from econometric modelling are supported by a more granular wood supply analysis completed in Virginia and North Carolina revealing tight pine pulpwood markets in the Coastal Plain with little room for further utilization, driving a cluster of industrial pellet plants located there to rely on hardwoods (Prisley, 2014).

Pellet mills operating in such areas will be highly dependent on both upland and bottomland hardwoods as their primary feedstock and will draw upon this resource heavily. The pellet industry readily acknowledges that sourcing trees that are "not usable" as sawtimber is a component of their sourcing strategy, contending that harvesting of these trees is not new, and that such harvests support and do not directly compete with other low value markets. Moreover, the industry posits that these markets support creation of heterogeneous habitats at the landscape-scale, which in turn support a broader array of species than do forests more homogeneous in age class.

Still, a major point of contention with environmental groups is what they perceive to be the removal of previously non-marketable trees as feedstock for wood pellets. This is raising concerns on two fronts, biodiversity and carbon balance. Some hardwood forests have high biodiversity value, especially bottomland hardwoods¹⁰⁸ (see section on Forested Wetlands in section 2.1.2) and represent a significant and increasing carbon stock. Sawtimber markets and landowner decisions functionally dictate harvesting rates, meaning that hardwood harvests are not driven exclusively by pulpwood demand. Still, the presence of a major new pulpwood user

¹⁰⁸ It has been widely publicized that demand for energy is increasing pressures on forested wetlands in the southeast US. While sourcing from wetlands does occur, there are other significant markets impacting forested wetlands in the South. For instance, Conner et al. (2012) reported that as much as 30% of cypress harvesting in the state of Georgia in 2007 went into mulch. In Florida, as much as 65% (over 232,000 cubic meters) of the cypress harvest in 2009 went into mulch, a low value market for an ecologically valuable tree species.

certainly is felt, especially in tight fibre baskets and areas previously lacking markets.

The forestry sector tends to view this as a beneficial thing, in part because hardwood forests in the Southeast have been severely high-graded, resulting in a predominance of low-grade timber volumes. From a silviculturalist's perspective, biomass harvests present an opportunity to help remedy this situation. From a wildlife ecologists perspective a regeneration harvest may also be a good thing if undertaken with an eye to habitat improvement. However, given the low rates of timber harvests on NIPF land that actually occurs as a silvicultural prescription in conjunction with a management plan, or even with direct consultation of natural resources professionals, prospects for using biomass harvesting as a silvicultural tool for this purpose appear to be minimal. If increased harvesting of upland hardwoods contributes to forest type conversion, there also will be direct negative ecological consequences.

In terms of carbon, a recent analysis used the UK Department of Energy and Climate Change's Biomass Emissions and Counterfactual (BEAC) model to examine the utilization of additional bottomland hardwood harvests for pellets, finding that such a forest energy system does not yield GHG reduction benefits compared to the 285 kg CO₂e/MWh standard of the UK Department of Energy and Climate Change (Stephenson & MacKay, 2014; Buchholz & Gunn, 2015). It is important to note that the feedstock production scenarios within the BEAC model are now undergoing additional research to determine the accuracy of assumptions in the BEAC model (see Matthews et al., 2015).

Key conclusions for effect 3:

- › Wood pellet mills in the southeast US are currently sourcing from areas identified as having high biodiversity value.
- › Saturated pine pulpwood markets are driving new pellet plants to hardwood utilization in some places. This leakage could result in decreasing carbon stock in southeast US.
- › Some hardwood forests have high biodiversity value, especially forested wetlands (see section on Forested Wetlands in section 2.1.2) and represent a significant and increasing carbon stock. Sawtimber markets and landowner decisions functionally dictate harvesting rates, meaning that hardwood harvests are not driven exclusively by pulpwood demand. Any eventual decrease in carbon stock may therefore be only partly attributable to biomass for energy demand.
- › Harvesting of hardwoods is forecasted to increase across the Southeast but future scenario modelling suggests that on the balance removals are unlikely to outstrip growth at the regional level. Removals in pellet mill supply areas, however, could lead to localized impacts to biodiversity, growth-to-drain ratios, and forest characteristics, such as reduced growing stock, but also increased heterogeneity in forest structure and age. This may have a negative effect on carbon stock in some forests.

- › Conversion of natural forests containing high biodiversity to pine plantations is a concern. Projected demands for pellet exports and domestic bioenergy suggest the practice will continue.

6.4 Effect 4: Environmental consequences of economic displacement and leakage in forest product markets.

Commonly raised question(s):

What are the environmental implications of increased competition, leakage, and displacement associated with growing demands?

Competition with traditional pulpwood users

How industrial pellet mills compete in the market depends on their ability to pay for their raw material. Forest bioenergy is often cast as the bottom feeder of the wood using industries. For the most part this is true, but the subsidized pellet export sector in the Southeast US is sourcing feedstocks that are also used to make paper, paperboard, and building products.

About 33% of the delivered cost of pellet feedstock is the stumpage price paid (Abt et al. 2014). Subsidies in EU member states are reducing feedstock procurement cost limitations, which in theory enables pellet mills to compete more for feedstock.

Evidence is mixed on how the industrial pellet sector competes with the traditional wood products industry. In some regions of the Southeast, pellet mills can compete just fine for fibre, whereas in others, this is not the case. Pöyry (2015) suggests that industrial pellet mills in the Southeast US are at a clear disadvantage to pulp and paper and other products, but are able to compete with OSB to some degree. Other pulpwood users can afford to pay \$63 - \$160 per ton delivered cost, whereas industrial pellet mills can afford around \$40 per ton delivered (Forisk Consulting, 2015a; Hawkins Wright, 2015a; Pöyry, 2015). Analysis presented by the American Forest & Paper Association (AF&PA) based on RISI data, however, suggests that UK power plants are capable of purchasing wood pellets for \$215 - \$275 per metric ton when subsidies from the Renewables Obligation and Contract for Difference are factored in. Yet, Hawkins Wright estimates that under the UK Contract for Difference scheme, power plants in the UK are capable of purchasing their feedstock at the port of entry towards the lower end of AF&PA's range.

This is a cost range that according to AF&PA translates to enabling industrial pellet mills \$28 - \$58 per metric ton of pulpwood stumpage, which is significantly greater than the current pulpwood stumpage price averages across the Southeast (see Figure 24), meaning that feedstock costs are perhaps not a limiting factor for pellet mills. Others have also concluded that it is unclear just how subsidies are affecting the ability of wood pellet mills to pay for feedstocks (Hoefnagels et al., 2014a).

Displacement and leakage

Some attempts have been made to solicit what levels of demand and corresponding feedstock hikes result in displacement and market leakage. Under a “high demand scenario” (60 million green tonnes for domestic and export bioenergy markets), the USDA Forest Service suggests that significant price increases in non-sawtimber stumpage occur (Wear, 2013). A slightly more conservative estimate integrates an energy demand scenario produced by Forisk Consulting and suggests possible near-term (out to 2020) aggregate energy demand of approximately 39 million green tonnes. This level of demand translates to a supply need of about 38% of the non-sawtimber removals harvested in the South in 2011, and would certainly present competition to other pulpwood users.

However, feedstock inputs to pulpwood-based industries are price inelastic, meaning that as demand for these feedstocks increases; subsequent feedstock price increases usually result in a less than proportional supply response from landowners, especially those growing pine for sawtimber markets. Therefore, as pulpwood prices increase harvest rates do not generally proportionally increase.

With these relationships in mind, Abt et al. (2014) conclude that the market will be slow to adjust to the rapid price increases happening, and that this will lead to market leakage and/or displacement in the short-term, concluding that “either demand will be met by imports from another region or country, or mill production will be reduced due to the high feedstock prices.” The analysts assume that significant market restructuring and market-induced changes in forest management could occur in association with increasing non-sawtimber feedstock prices.

If non-sawtimber Roundwood prices continue to rise, and pellet mill paying capacity truly is approaching levels suggested by AF&PA, then the export pellet market could begin to use larger diameter Roundwood and/or motivate traditional users of pulpwood to use larger diameter Roundwood (chip-n-saw and sawtimber). We found no concrete evidence that the latter is currently happening. Still, over the longer-term higher prices could result in a planting response and more forest carbon being added to the landscape, which could over time theoretically compensate for initial losses caused by increased harvesting.

Factors that may reduce competition

Several activities in the market may reduce competition and possible negative effects. For instance, as the housing market continues to recover additional mill residuals could become increasingly available for pulpwood users, releasing some pressure on pine pulpwood prices, perhaps increasing mill residual availability by 30% (Abt, 2014).

Location of new pellet demand is a deterministic factor in whether pellet mills contributed to economic displacement or replacement. In the Southeast US there has been a 29.5 million green tonne reduction in pulpwood demand from other pulpwood-based industries since 1998, mostly in the form of hardwood from pulp and paper mills, which have closed. At the same time, the total demand from operational, announced, and under construction, pellet mills in the region equals

25.9 million green tons (Forisk Consulting, 2015a; Forisk Consulting, 2015b; Forisk Consulting, 2015c).

Some of these pellet mills are using hardwood feedstocks in areas of closed paper mills, which previously relied on these resources. Other pellet mills are locating in the few places in the region where pine pulpwood demand has decreased. Hawkins Wright (2015b) cites seven instances where operational industrial pellet plants have located near closed wood using facilities. Overall, data from timber market consultancies suggests that the purposeful locating of pellet mills near or away from other wood users is mixed across the Southeast US.

Competition could also be alleviated by pellet mills and competing industries finding ways to utilize logging residues, which are a low cost, and low risk feedstock from a GHG emissions perspective. As discussed elsewhere in this report higher logging residual utilization rates could pose trade-offs to stand-level biodiversity and other values. Research into the use of logging residuals for the European market has found that the current configuration of the pellet export industry makes higher utilization rates of logging residuals challenging for technical and logistical reasons (Hoefnagels et al., 2014b).

Key conclusions for effect 4:

- › Some additional demand can still be absorbed by the region, but at some point, economic displacement and leakage would occur. Estimates vary on when and at what level of demand this happens and what environmental consequences there may be.
- › Potential negative environmental effects associated with market leakage and displacement could include making attainment of GHG reduction targets more difficult.
- › Over the next few years, demand for pulpwood and other non-sawtimber Roundwood categories attributed to industrial wood pellet plants is expected to increase to just below that of the region's OSB panel market.
- › Future demand for forest biomass feedstocks for US-based energy could increase. While this sector would be capable of using logging residues, pulpwood would be needed too (Abt et al., 2010; Galik et al., 2009).
- › While timber area expansion in response to increasing demand may be one possible future, timber markets adjust slowly to rapid increases in demand and price. Market effects, such as a planting response or conversion of natural forest to pine, that may already be in motion may not be evident for a while.
- › Under demand scenarios modelled by Abt et al. (2014) market leakage would be expected, which again could lead to displacement having negative GHG effects
- › While feedstock prices are expected to rise, high pulpwood prices are unlikely to exclusively justify timberland ownership, especially with land being

increasingly valuable for agriculture. However, high non-sawtimber prices do influence harvest decisions, especially during a depressed housing market.

- › The traditional forest products industry is concerned about rising prices because it affects profit margins and their ability to compete globally. Given the size and global importance of the Southeast timber market (17 – 28% of global Roundwood; 1999 - 2012) (Prestemon et al., 2015) structural changes within southeast fibre markets could have rippling effects globally (Hewitt, 2011). The scale and nature of such impacts are very difficult to predict.
- › Location of pellet mills, increased availability of mill residuals, and use of logging residues could alleviate competition with other industries.
- › We find that EU subsidies, in the case of UK, allow pellet users to procure biomass at prices above the current pulpwood stumpage price averages across the Southeast, meaning that feedstock costs are perhaps not a limiting factor for pellet mills. This, in turn indicates that if non-sawtimber Roundwood prices continue to rise, and pellet mill paying capacity truly is approaching levels suggested, then the export pellet market could begin to use a broader resource base.

7 Analysis of effects of EU wood pellet demand observed in the Southeast US

Preceding sections described prevalent forest conditions in the US Southeast, its current regulatory and socio-economic environment, and outlined the process of biomass for energy production (focused on wood pelletization) with a focus on potential environmental implications of greater biomass demand. This section of the report presents a statistical analysis and synthesis of some key reports from the scientific literature specifically aimed at gauging the net (i.e. marginal) effect of Directive 2009/28/EC on forest conditions and markets of the US Southeast.

7.1 Market demand and forest sustainability

The consequences of increasing demand for pulpwood for pellets and other uses¹⁰⁹ are complex and actively debated. Perspective and context is important. For instance, positive growth-to-drain ratios at the regional or state-level are often pointed to as an indicator of forest sustainability. While inventories continue to increase, growth to drain ratios are roughly equivalent for much of the Coastal Plain, meaning that significant demand increases would likely not be sustainable in such locations without new supplies becoming available. In such instances, growth-to-drain ratios could dip below 1, an indication of demand outstripping supply, at least until market corrections or leakage occurs.

Some historical perspective is important for a full understanding of these issues. Based on observations from past periods of increased pulpwood demand, conventional views on Southeastern forest economics are that increasing wood demand begets increased harvesting but also increased investment in forests (more pine planting) and subsequent expansions in forest area, inventories, and carbon stocks, over the long-term (Miner et al., 2014; Abt et al., 2014; Hardie et al., 2000; Lubowski et al., 2008; Nepal et al., 2012; Nepal & Skog 2012; Malmsheimer et al., 2011; Abt et al., 2012).

¹⁰⁹ Oriented strand board (OSB), other wood panel and composite wood products, paper, and packaging.

Yet, while demand for pine sawtimber and pulpwood stayed relatively stable and high over the last quarter century (until its recent crash), the area of trees planted by private landowners has dropped over the last 25 years (Abt, 2014). Regardless, over the last 60 years, the Southeast has enjoyed steadily increasing timber inventories, which continue to expand. Even with pine pulpwood production presently being at an all-time high, timber volumes in multiple forest types continue to expand, with net-growth exceeding timber removals at the regional and state levels.¹¹⁰

Going forward, several studies have investigated the potential impacts growing demands could pose to the sustainability of forests in the Southeast US (Abt et al., 2014; Alavalapati et al., 2013; Abt & Abt, 2013; Galik et al., 2009; Abt et al., 2010; Colnes et al., 2012; Abt et al., 2013; Evans et al., 2013a; Galik & Abt, 2015). The region is already one of the most intensively managed forest landscapes globally and industrial wood pellets are the most significant new market in quite some time.

Price and economic drivers

The US housing market is the main driver of timber production and forest management in the Southeast US. During the recent economic recession the US experienced a significant housing downturn, resulting in weak markets for dimensional lumber and wood panelling products like oriented strand board (OSB). The recession affected both sawtimber and pulpwood markets (see discussion of pulpwood prices below).

Leading up to the recession, a large portion of the region's pine planted during significant growth of the US economy in the early 1990s, had reached the sawtimber diameter class. As a result new plantings have tapered off and in response to the housing downturn (40% reduction in housing prices) landowners delayed sawtimber harvests (30% reduction) reducing the supply of both sawlogs and pine pulpwood volumes (Abt, 2014). While demand for sawtimber and hardwood pulpwood has slackened, pine pulpwood demands continued to rise as pulpwood product mixes rely increasingly on pine fibre. Both of these things, a pinch on the pine pulpwood supply and an increase in pine pulpwood demand has resulted in increased pine pulpwood prices. This is affecting the pellet export industry in a number of ways.

¹¹⁰ Appendix B contains information on growth-to-drain ratios at the state-level as measured by FIA data.

Pulpwood price trends

In recent years, in front of the additional demand coming from the industrial wood pellet export market, pine pulpwood prices had already increased (Forest2Market, 2014; Timber Mart South, 2015; Abt, 2014; Abt et al., 2014; RISI, 2015a; RISI, 2015b; RISI, 2015c; Forisk Consulting, 2014). Recent pulpwood pricing data produced by Timber Mart South indicates that stumpage prices increased from 2011 - 2014 (+25% pine pulpwood; +60% hardwood pulpwood). The regional average delivered price for pulpwood also increased over this time period (+15% pine pulpwood, +22% hardwood pulpwood) (Timber Mart South Q2 2014; Forisk Consulting, 2014). Likewise, Forisk Consulting (2015c) suggests that all other market conditions being held equal, average pine pulpwood stumpage prices across the Southeast US could increase by 31% 2014 to 2019.

Further price increases are expected for the next few years as pine pulpwood inventories remain low. The southeast pulp and paper industry presently represents 80% of the demand on pulpwood in the region, as compared to 4 – 6% for wood pellets (Forisk Consulting, 2015b). More demand from the traditional industry is being placed on the pine plantation estate, as hardwood pulpwood utilization for paper products has declined and pine pulpwood use has increased for fluff pulp and packaging products.

Going forward, the traditional forest products industry is projected to increase from 188 million dry short tons in 2014 to 201 million dry short tons in 2019, an increase of 6.9%, much of which will be concentrated on pine (RISI, 2015a; c). At the same time, projected demands from industrial wood pellets is expected to increase to about the size of the Southeast OSB market (Forest2Market, 2014; Forisk Consulting, 2014).

For analysis of potential effects and their relation to market drivers the key question is what are the likely effects on pulpwood prices of these demand shifts, how will this effect competition, and what are the possible effects on the environment.

With a decrease in sawtimber harvests, most timber harvesting that occurred during the recession and immediately after was thinnings producing smaller diameter logs for pulpwood dependent industries. Prisley (2015) documents these market dynamics in his recent analysis of pine pulpwood scarcity in Virginia. This baseline analysis of the Virginia wood supply revealed that pine pulpwood prices increased between 50 – 100% across Virginia in the last four years.

One conclusion that can be drawn is that these market dynamics have affected the selection of feedstocks by the industrial pellet sector in this part of the Coastal Plain. This is evident by the self-reported volumes of hardwood in the pellet mills exporting from the Port of Chesapeake, Virginia (Prisley, 2015) and in the results of the *ex post* analysis of pellet mill supply areas herein.

Projections of possible futures

Long-range economic projections of fibre markets can be fraught with uncertainty and have been shown to have significant error relative to subsequent measurement of actual outcomes, especially when forecasts are made a decade or more into the future (Buchholz et al., 2013). Still, predictive models can be useful to better understand the dynamics of wood demand and landowner supply response when such models are based on reasonable assumptions and input variables.

Most economic analyses (in the US) utilize the Subregional Timber Supply (SRTS) model, a timber market projection system. This timber market equilibrium model is based on parameters derived from past econometric studies, USDA Forest Inventory Data, and exogenous demand forecasts. The SRTS model utilizes field inventory and timber product output data to characterize resource conditions and harvest activity. Two prominent studies, which have recently used this approach, are profiled here because they were commissioned by the US Federal government to address similar questions as this study.

Southern Forest Futures Project

An analysis of forest bioenergy markets completed for a region-wide forward looking assessment known as the Southern Forest Futures Project suggests that the net-effects of additional wood demand for energy as forecasted in DOE's Annual Energy Outlook could result in structural changes in regional fibre markets over the medium-to-long-term. Modelling of high regional demand scenarios showed significant price increases with economic displacement predicted to occur sometime around 2030 (Alavalapati et al., 2013; Wear, 2013).

DOE and Forisk Consulting

Under low-to-medium US energy demand scenarios developed by DOE and Forisk Consulting, energy wood supply requirements could increase to more than 50 – 85% of the wood supply requirements of the existing forest products industry as of 2010. For reference, historical southern wood product output fluctuated between 250 – 275 million green tonnes from 1995 to 2007, dipping below this output during the recession. Under high energy demands projected for 2050, supply requirements for energy alone could grow 113% of the wood supply requirements of the existing forest products industry in 2010 (Abt et al., 2014). Economic displacement and significant restructuring of timber markets likely occurs prior to reaching levels of additional forecast demand as high as this.

Market projections in context:

Removals of forest fibres for wood pellet manufacturing in the context of Southeastern US timber product output removals.

Recent levels of timber removals from the Southeastern US from 1995 through 2011. Timber removals distinguish between removals for softwood and hardwood pulpwood and sawtimber, and for industrial wood products and composites. The report by Abt et al. (2014) is based on data from (a) the Timber Product Output (TPO) available through the US Forest Service (2014b) which were derived from surveys of both traditional wood processing facilities (e.g. pulp, paper, and composite mills) and bioenergy and pellet producers, and (b) Forisk Consulting operating bioenergy production levels which estimates were subtracted from the bioenergy and pellet production from the TPO category of “other industrial wood”. Forisk Consulting data were derived from surveys of operating and announced bioenergy producers (Forisk Consulting, 2014). These estimates suggest a small but growing volume of historic timber removals used to manufacture pellets in the Southeastern US. These represented about 0.1% of all removals in 2007, 0.3% in 2009 and 1.3% in 2011.

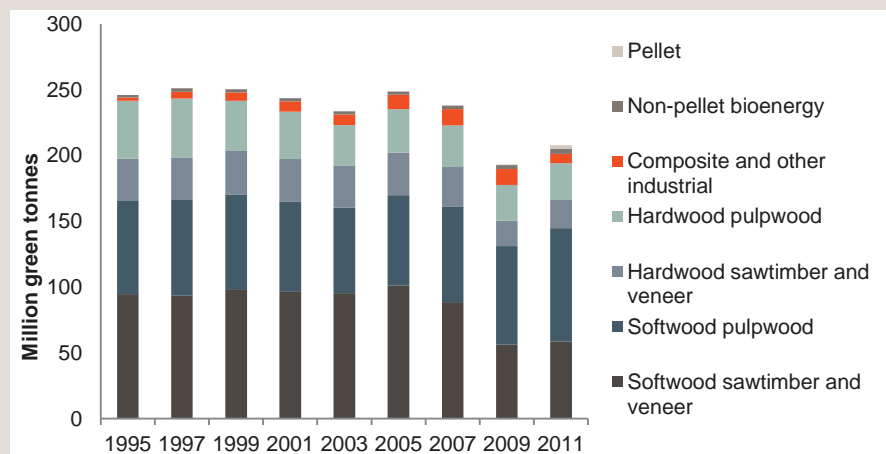


Figure 36. Timber product output removals for Southeastern US (1995-2011). Source: Adapted from Abt et al. (2014).

7.2 Analysis of marginal impacts of EU demand

Impacts of greater demand from the EU for wood pellets on US local forest resources are difficult to discern. A major driver of the rapid growth in pellet production and export in the Southeastern US has unquestionably been Directive 2009/28/EC of the European Parliament (Abt et al., 2014, Lantiainen et al., 2014). Nevertheless, demand for wood pellets and bioenergy in general is a combined function of domestic and international market forces. In the US, state regulations like Renewable Portfolio Standards (requiring the contribution of renewable sources to electricity portfolios in numerous states) and federal programs (such as the Public Utility Regulatory Policies Act and the more recently adopted Clean Power Plan) can also influence demand for wood for electricity generation (Aguilar

et al. 2011). Among US households, factors including efficiency and opportunity costs have as of recently supported expansion of the use of wood pellets for heating (Berry 2014).

To disentangle the effects of EU2020 targets on forests of the Southeastern US one analytical approach includes the comparison of observed trends with other regions used as proxies for a counterfactual scenario against which estimated trends can be contrasted and public policy impacts inferred. In the case of future impacts, historic trends that provide baseline conditions can be compared to projections for future markets where there will be a greater demand for wood fibres for pellet manufacturing. Deviations from historic trends quantify possible policy effects, provide intuition for what resource impacts have been, and are likely to be in the future.

The study of impacts of greater EU wood pellet demand on forests of the Southeastern US relied on:

- › An *ex post* systematic assessment of trends in attributes of forests of the Southeastern region, compared with trends in another region not affected by EU demand; An *ex post* statistical model to evaluate net effects of proxy variables likely associated to Directive 2009/28/EC, on selected forest attributes;
- › An *ex ante* evaluation of changes in future forest conditions based on projections for future growth in bioenergy markets and compared against a projected baseline that assumes no new bioenergy demand.

Impacts were determined by examining changes in selected forest attributes derived from data from the US Forest Inventory and Analysis (FIA) Program conducted by the USDA Forest Service (O'Connell et al. n.d.). The data were supplemented with other sources of information to help discern the likely changes in forest attributes linked to Directive 2009/28/EC. It is important to stress a lack of consistent historic regional or national data on wood pellet industrial manufacturing in the US. The recent acceleration in wood pellet manufacturing in the US, being unprecedented, also complicates year over year tracking in installed manufacturing capacity and actual production. Moreover, the period over which wood pellet manufacturing has expanded provides a relative short timeframe over which any impacts on forest resources can be measured. Environmental impacts might occur over short-, medium- and long-term periods and require monitoring of different attributes that describe the area, structure and composition of forest resources. Figure 37 depicts the *ex post* and *ex ante* approaches used to evaluate past and expected future forest conditions.

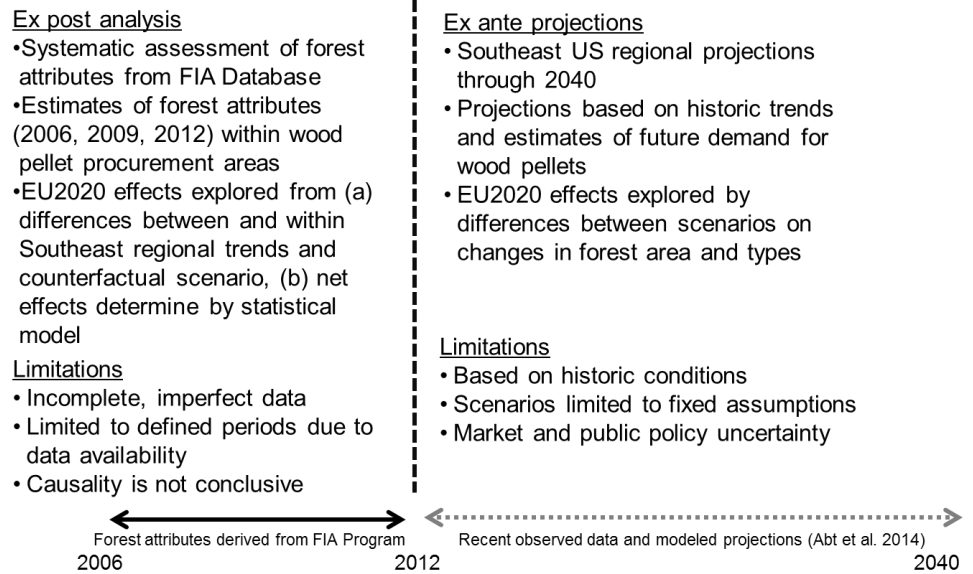


Figure 37. Outline of ex post and ex ante analyses to explore effects of greater EU wood pellet demand on forests of the Southeastern US.

7.2.1 Ex post assessment of changes in localized forest attributes within wood pellet procurement areas: Regional trends and statistical model of counterfactual analysis

The link between the adoption of Directive 2009/28/EC and growth in US Southeastern installed wood pellet manufacturing capacity and exports is evident, but the identification of policy-specific effects requires the evaluation of conditions that would lend for comparison with counterfactual scenarios. In this study, the likely impacts of EU2020 targets on forests of the Southeastern US were conceptualized based on the framework outlined in Table 7-1. Expected effects of EU2020 targets on local forest resources is denoted by “+” symbols with “+++” suggesting greater impact and “+” a lesser level of discernible impacts. In the case of the Northeastern interior region for instance there is no expected effect of EU2020 and demand for wood pellets is largely driven by US domestic consumption. This was a condition taken for its identification as a counterfactual scenario.

Table 7-1. Conceptual framework to discern effects of EU2020 targets and US domestic market effects on woody biomass demand across the US East region.

| | US East Region | | | |
|---------------------|----------------|----------|---------------|----------|
| Regions | Southeastern | | Northeastern† | |
| Impacts | Coastal | Interior | Coastal | Interior |
| EU-policy | +++ | ++ | + | |
| US domestic markets | + | + | ++ | +++ |

† Used to provide counterfactual conditions to the development of wood pellet plants in the Southeastern US. South Coastal states: AI, FL, GA, MS, NC, SC, VA; US North Coastal states: CN, DL, MA, MD, ME, NH, NJ, NY, PN, RI; US South Interior states: KY, TN; US North Interior states: IA, IN, IL, MI, MN, MO, OH, VT, WI, WV

The identification of counterfactual scenario for policy assessments aims to identify a comparable situation where quantifiable data are available over similar time periods the policy has been in effect, where initial conditions were similar, hence, net differences in trends likely associated to policy effects. This counterfactual framework was used to guide the *ex post* analysis by:

- › Examining differences and commonalities in overall trends in the Southeastern US against the counterfactual region (Northeastern US). Changes in average forest attributes across main procurement areas of wood pellet plants were estimated to discern region-wide trends over the periods 2006-2009, 2009-2012 and 2006-2012. Over these periods, estimated changes in total pellet capacity were 3.5 million tons (2006-2009), 2.5 million tons (2009-2012) and 6 million tons (2006-2012). Most recent information, i.e. after 2012, could not be included in the analysis because it was not yet fully available from the FIA database at the time of this study. Change over 3- and 6-year periods was calculated on a percent basis as follows: $(\text{FIA attribute base year} - \text{FIA attribute end year}) \times \text{FIA Attribute base year}^{-1} \times 100$.
- › Examining differences and commonalities within the Southeastern US region and the counterfactual Northeastern US. A distinction between wood pellet plants located in coastal and interior states explored trends in areas most likely to be impacted by EU policy (Table 7-1 above).
- › Exploring net effects of EU2020 renewable energy policies using statistical models. Covariate information was included to control factors that can help explain changes in selected forest attributes. These included: (a) presence of a pellet plant, (b) years of pellet plant operation, (c) pellet operation in the Southeastern US interior states, (d) pellet operation in Southeastern US coastal states, (e) pellet operation in Northeastern US coastal states, (f) pellet capacity over 100,000 tonnes/year, (g) overall Southeastern region effects, (h) overall Northcoastal region effects, (i) distance to nearest urban areas, and (j) overlap with pulpmill procurement areas (as estimated by 75-mile, 120.7km, procurement area from the location of a pulpmill). Marginal effects associated with the RED were captured through the direction, magnitude and statistical significance of (c) pellet operation in the Southeastern US interior states, (d) pellet operation in Southeastern US coastal states, and (e) pellet capacity over 100,000 tonnes/year. Statistical models used a standardized regression to ease comparison across forest attributes measured in different units (Greene, 2012). Hence, their interpretation is based on how a change in a particular condition was associated with a change in the number of standard deviations of selected forest attributes.

It is worth emphasizing that counterfactual policy outcomes are by definition not directly observed and must be estimated (Ferraro, 2009). In this analysis, the Northeastern region was selected as a counterfactual region based on similarities in conditions at the beginning of the evaluation period. Nonetheless, differences exist, as there is impossible to find perfect matching scenarios to discern policy impacts in any 'natural experiment'. Thus, the use of counterfactual scenarios, although an important tool to help answer policy questions, can never

unequivocally determine causation. Among similarities and differences found between the regions:

Similarities

- > Pelletization manufacturing process
- > Similar growth rate in industrial installed capacity over time periods (2006-2012)
- > Region located within the US, same federal laws and regulations
- > Consistency in forest attribute data collection protocols across sites and years (FIA Program)
- > Identical sampling areas defined by concentric circles
- > Presence of conifer and broadleaf dominated forest landscapes

Differences

- > Non-identical forest ecosystems
- > Different levels of industrial growth in recent years
- > Heterogeneity in state-level forest policies

Data: Wood pellet industry and forest attributes

The project Wood2Energy (wood2energy.org) led by the Center for Renewable Carbon at the University of Tennessee with funding from the US Endowment for Forestry and Communities Inc., and in cooperation with the Biomass Energy Resource Center Biomass Power Association, Biomass Thermal Energy Council, Pellet Fuels Institute, USDA Forest Service and the Sun Grant Initiative has compiled a database of industrial facilities utilizing wood as a fuel source. The database includes facilities classified as ‘Wood pellet producer’.

The database provides information on plant location (sometimes as latitude and longitude, otherwise company headquarters were used), but data on plant capacity and year of installation were incomplete in the most current version (Khaliukova, 2015). Data from Wood2Energy database was downloaded on April 2015. Queries for “Facility type” identified as “Wood Pellet Producer” and “Operational” yielded 411 facilities in the US and Canada. Of these, 264 operating pellet plant facilities are located in Eastern US (North and Southeastern). Removing duplicates and plants manufacturing products other than wood pellets (e.g. charcoal), the final database consisted of 79 facilities in the Southeastern US and 123 facilities in the Northeastern US. Figure 38 (left side) shows the location of the operational wood pellet manufacturing plants retrieved from the Wood2Energy database. The representation also distinguishes between pellet plants of reported capacity of at least 100 thousand tons per year, signifying plants more likely to target export markets. Figure 38 (right side) presents the same information for the Northeastern US. The database identified 20 pellet plants of annual capacity over 100 thousand tonnes in the Southeastern US and only 7 in the Northeastern US.

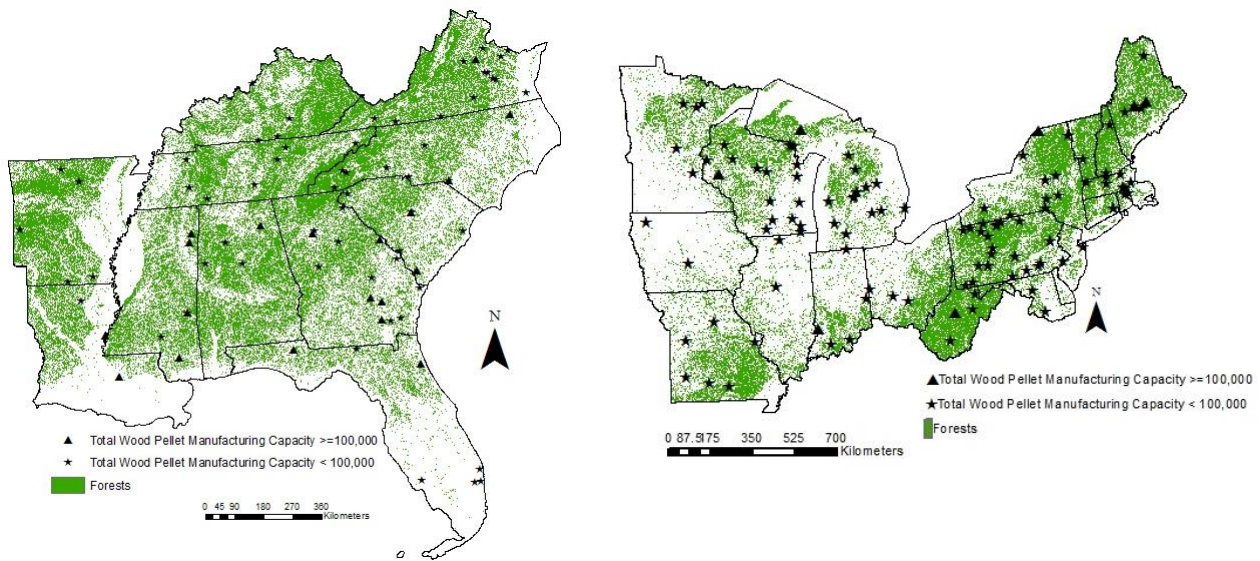


Figure 38. Location of wood pellet manufacturing facilities in the (left) Southeastern and (right) Northeastern US distinguishing between those with known manufacturing capacity of at least 100 thousand tons per year. Source: Wood2Energy.org.

Forest attributes within procurement areas of operating wood pellet plants were retrieved from the FIA database. Table 7-2 shows the main descriptors of the FIA data, a brief description and rationale for their inclusion to estimate impacts on local forest the main descriptors of the FIA data, a brief description and rationale for their inclusion to estimate impacts on local forests.

Table 7-2. Description of forest attributes derived from the US Forest Inventory and Analysis database for samples denoting wood pellet plant procurement areas†

| FIA original attributes* | Estimation | Proxy impacts |
|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Area of timberland, in acres | Forestland that is producing or capable of producing in excess of 20 cubic feet per acre (1.40 m ² per ha) per year of wood at culmination of mean annual increment. Timberland excludes reserved forestlands. Estimates derived from remote sense imagery and FIA plot data. | Changes in forest cover to other uses (excludes reserved and other forest land) |
| Net volume of live trees (at least 2.54 cm at 1.37 m above the forest floor), in cubic feet, on timberland | For timber species (trees where the diameter is measured at 1.37 m above the forest floor this is the net volume of wood in the central stem of a sample tree ≥12.7 cm in diameter, from a 30.5 cm stump to a minimum 10.16 cm top diameter, or to where the central stem breaks into limbs all of which are <10.16 cm in diameter. Does not include rotten, missing, and form cull. | Changes in net volume of live trees per area |
| Number of live trees (at least 2.54 cm d.b.h./ diameter at root collar), in trees, on timberland | Number of live trees estimated using expansion factor(s) to scale each tree on a FIA plot to a per-acre basis | Changes in the number of trees per area. Evaluated in conjunction with above and belowground carbon in live trees to denote how changes in number of trees may have resulted (or not) in levels of carbon |

| | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | from this pool |
| Number of standing-dead trees (at least 12.7 cm d.b.h./ diameter at root collar), in trees, on timberland | Number of standing-dead trees estimated using expansion factor(s) to scale each tree on a FIA plot to a per-acre basis | Changes in forest characteristics important to wildlife habitat. Evaluated in conjunction with above and belowground carbon in standing-dead trees to denote how changes in number of trees may have resulted (or not) in levels of carbon from this pool |
| Above and belowground carbon in live trees (at least 2.54 cm at 1.37 m above the forest floor), in short tons, on timberland | Live tree carbon pools include aboveground and belowground (coarse root) biomass of live trees with diameter of at least 2.54 cm at 1.37 m above the forest floor | Changes in carbon stored in biomass above and belowground (live tree carbon pools). |
| Above and belowground carbon in standing-dead trees (at least 2.54 cm at 1.37 m above the forest floor), in short tons, on timberland | The standing dead tree estimates are primarily based on FIA plot-level measurements. This C pool includes aboveground and belowground (coarse root) mass and includes trees of at least 12.7 cm | Changes in carbon stored in dead trees of importance for wildlife habitat (dead tree carbon pools) |
| Carbon in organic soil, in short tons, on timberland | Soil carbon estimated from spatial database with data gaps filled with representative values from similar soils | Changes in soil organic (i.e. non mineral) carbon |
| Average annual harvest removals of live trees (at least 12.7 cm at 1.37 m above the forest floor) in cubic feet, on timberland | Estimation of removals from timberlands. Volume of live trees cut in conjunction with a harvest operation. | Changes in intensity of harvesting |
| †Sampling area for procurement of wood fibres by pellet plants reported by Spelter & Toth (2009) and Natural Resources Defense Council (2015) of 50-mile (80.47 km) radius around georeferenced wood pellet plant locations. *Original FIA data given in English units, later converted to metric system. Forest attributes estimates derived following Bechtold et al. (2005). Data estimated for each sample procurement area for years 2006, 2009 and 2012 | | |

Forest Inventory and Analysis (FIA) Program:

The FIA program of the US Forest Service provides information to assess America's forests. The FIA program is a collection of related surveys designed to focus on different aspects of America's forested ecosystems. The forest monitoring component is the best-known component of the FIA program. This component consists of a systematic sample of sites across all forested lands of the US. One FIA field sample site is located for every 6,000 acres (2,428.12 ha) of forest, where field crews collect data on forest type, site attributes, tree species, tree size, and overall tree condition. Collectively, the forest monitoring component of FIA provides a nationwide systematic sample of a wide array of measurements on forested ecosystems. At the time of this study complete information from the FIA database was available up to the year 2012 with partial information for 2013.

Mean descriptors of forest attributes averaged across concentric circles around wood pellet plants representing procurement areas are presented for the Southeastern and Northeastern regions as defined in Table 7-3.

Table 7-3. Mean descriptors of forest attributes averaged across concentric circles around wood pellet plants in the Southeastern and Northeastern US.

| Timberland forest attributes | (000s) | Southeastern | | Northeastern | |
|-----------------------------------------------------|----------------|--------------|-----------|--------------|-----------|
| | | Year 2006 | Year 2012 | Year 2006 | Year 2012 |
| Area of timberland | Ha | 1,153 | 1,172 | 913 | 933 |
| Net volume of live trees | m ³ | 143,021 | 155,865 | 119,703 | 126,845 |
| Number of live trees | Trees | 2,017,879 | 2,018,552 | 1,461,082 | 1,490,425 |
| Number of standing-dead trees | Trees | 23,063 | 22,374 | 38,022 | 37,678 |
| Above and belowground carbon in live trees | Tonnes | 70,820 | 76,075 | 62,494 | 66,133 |
| Above and belowground carbon in standing-dead trees | Tonnes | 2,894 | 2,973 | 4,407 | 4,477 |
| Carbon in organic soil | Tonnes | 71,646 | 74,231 | 80,941 | 83,506 |
| Average annual harvest removals of live trees | m ³ | 3,644 | 3,937 | 1,201 | 1,371 |

Details on sampling areas and average density of FIA monitoring plots are included in Table 7-4. On average about 50% of sampled procurement areas of wood pellet plants were forested.

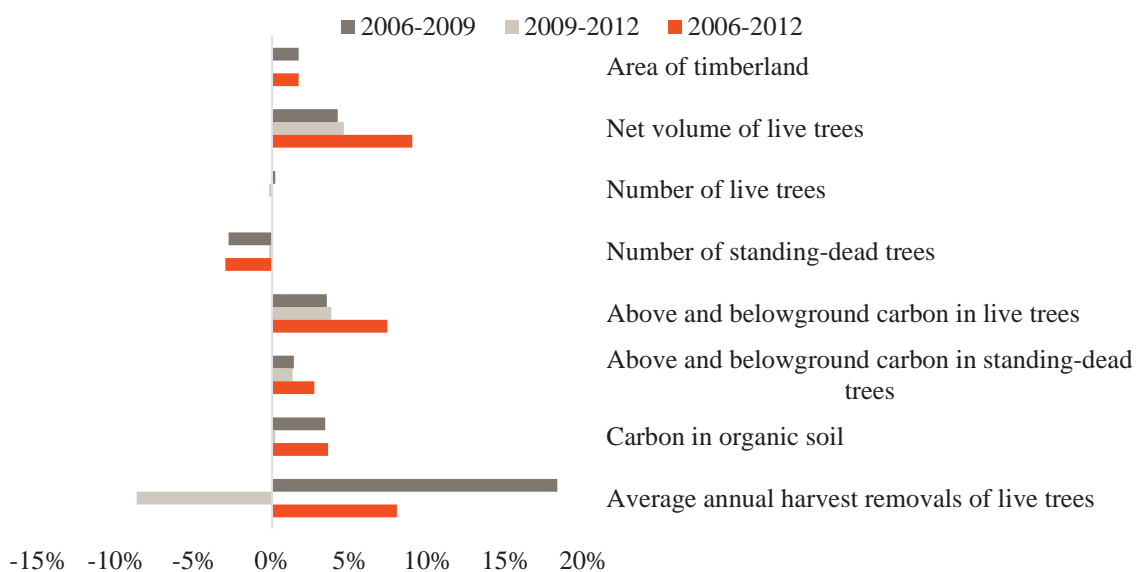
Table 7-4. Sampling areas and average density of FIA monitoring plots

| | Descriptive analysis | | Counterfactual analysis† |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------|--------------------------|
| | Southeastern | Northeastern | |
| Total number of wood pellet plants in sample* | 79 | 123 | 98 |
| Total area sampled in estimation (ha)‡ | 160,711,140.2 | 250,221,142.3 | 199,363,186.5 |
| Estimated average FIA field sample plots (total)† | 33,094 | 51,526 | 41,053 |
| Estimated average FIA field sample plots (annual) | 6,618 | 10,305 | 8,211 |
| *Concentric circles of 80.47 km of radius helped define procurement areas of 2,034,318.23 ha area. Attributes for each concentric circle were estimated independently. †Counterfactual analysis had a fewer number of concentric circles due to missing information necessary to estimate statistical models. | | | |

Results

Results from the *ex post* analysis of regional trends are shown in Figure 39 summarizing percent changes in average forest attributes within wood pellet plant defined procurement areas over selected time periods. Across the estimated procurement radii of pellet plants in the Southeastern US over the 2006-2012 period there is indication of an overall increase for many forest attributes ranging from area of timberland to carbon in organic soils. In the Southeastern region, within wood pellet plants procurement zones, there is indication of a declining number of standing dead trees over this 6-year period. There is general consistency in the trajectory of forest attributes over time with the only exception being the average annual harvest removals of live trees, which showed a decline over the 2009-2012 period. In addition, over the same 2009-2012 period there was a small decrease in the area of timberland within wood pellet procurement areas.

Classifying observations between coastal and interior Southeastern states shows that in coastal areas, where most pellet plants for export to the EU are located, similar trends were observed with an increase in all forest attributes with the exception of number of standing dead and live trees. However, there was no associated decline in the estimated amount of carbon above and belowground in either live or standing dead trees. These trends suggest that as forests have aged these carry fewer individual trees while maintaining or increasing actual standing biomass volume and, hence, carbon. There was also a small decline in area of timberland of about 0.11% within procurement areas of pellet plants in coastal Southeastern states over the 2009-2012 period, but a net increase of 0.54% over the longer 2006-2012 period. In interior Southeastern states, there was lesser evidence of a lower number of live or standing dead trees as compared to the coastal region. The distinction between coastal and interior states in the exploratory analysis is a first attempt to discern differences between wood pellet plants mainly targeting export versus domestic markets.



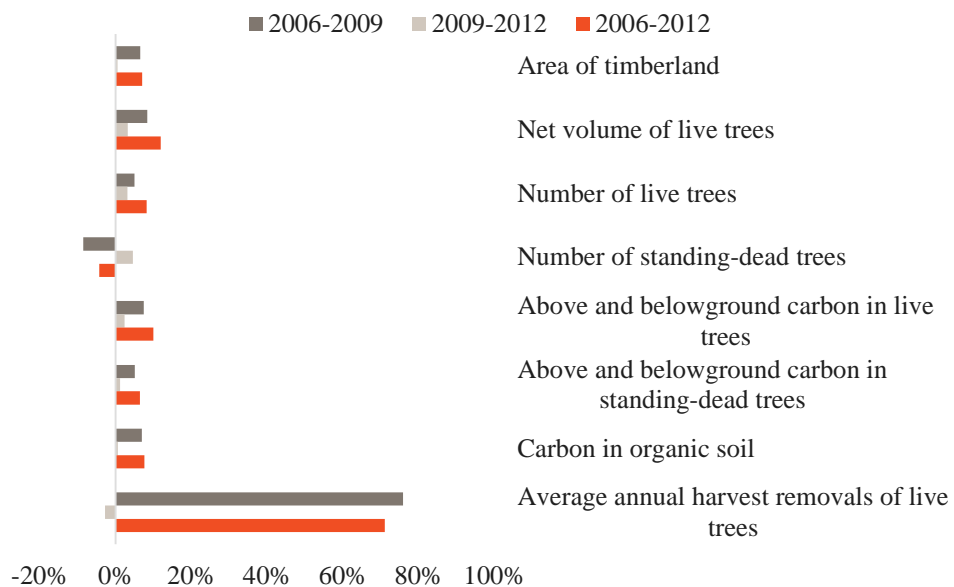
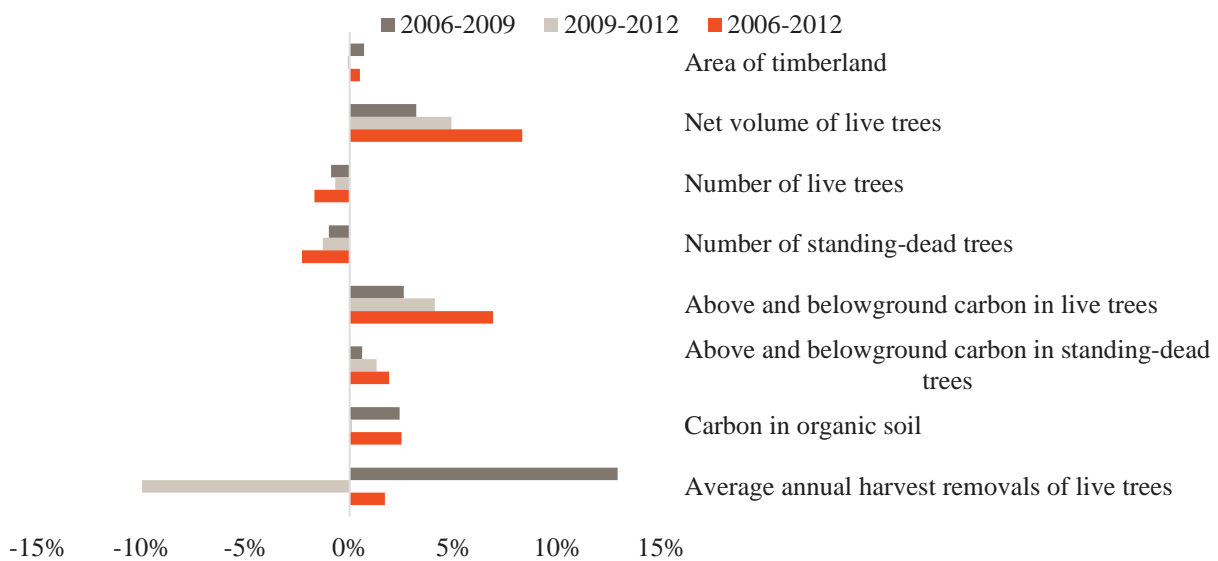


Figure 39. Estimated percent changes in selected FIA forest attributes within wood pellet plant procurement areas over three periods (2006-2009, 2009-2012, 2006-2012) in the Southeastern US (top), coastal states of the Southeastern US (middle) and interior states of the Southeastern US (bottom).

Distinction in trends by upland and lowland hardwood and conifer group species (Figure 40, Figure 41, and Figure 42) showed small differences in selected attributes over defined time periods. The conditions discussed in these figures correspond to the same FIA attributes presented previously with the exception of carbon in organic soils and annual harvest removals of live trees as these cannot be derived for species groups due to sampling and inference methods specific to species group estimation. A discernible trend was that of fewer standing-dead trees in conifer forest types (Figure 42) found in procurement areas around pellet mills across the US Southeast. Changes in forest attributes among upland hardwood species all showed positive increases over the six- and three-year periods.

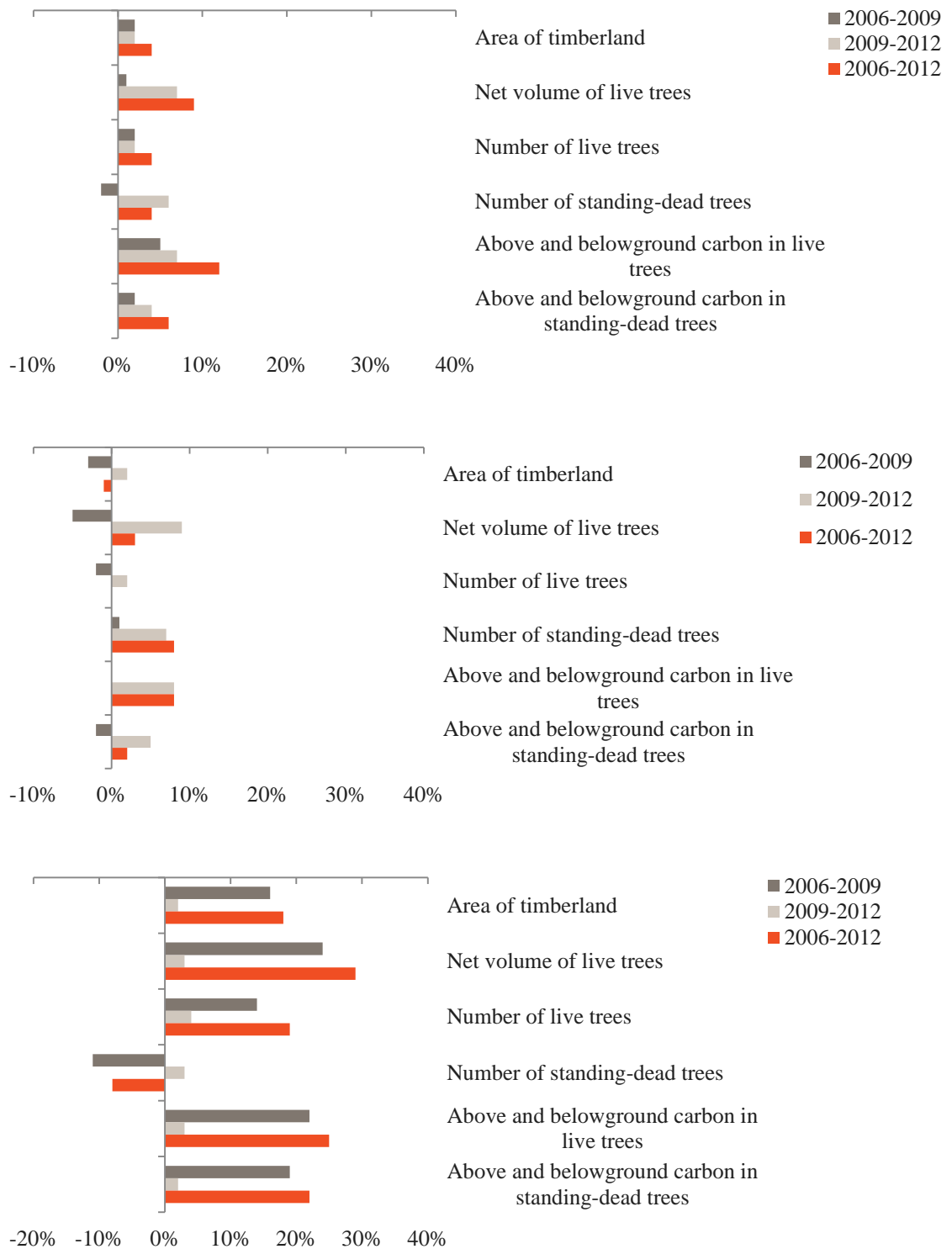


Figure 40. Percent changes in forest type group Oak/Hickory within wood pellet plant procurement areas over three periods: 2006-2009, 2009-2012, 2006-2012, in the Southeastern US (top), coastal states of the Southeastern US (middle) and interior states of the Southeastern US (bottom). Estimation of forest attributes carbon in organic soils and average annual harvest removals of live trees cannot be derived for concentric circles using FIA database by species group.

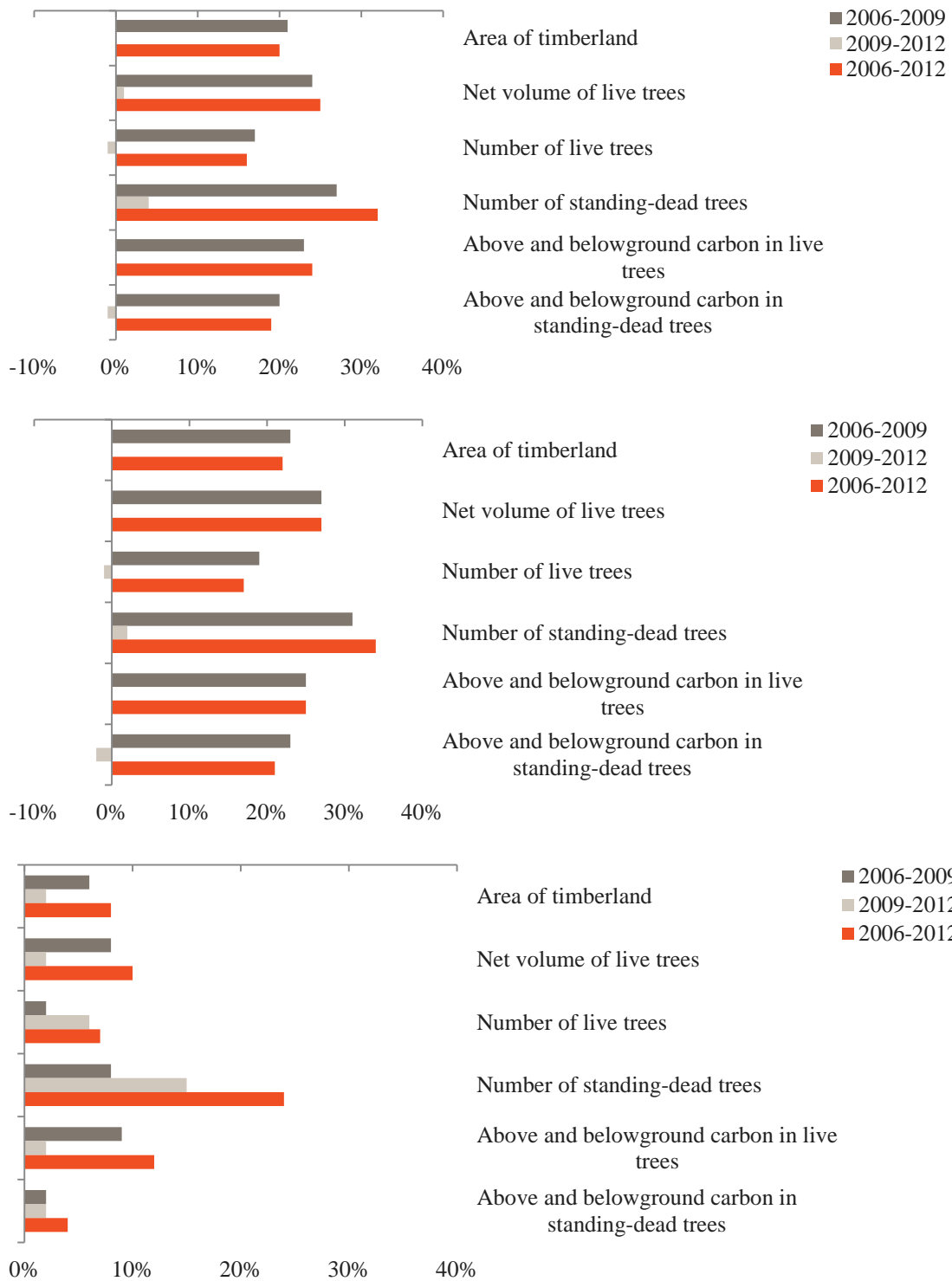


Figure 41. Percent changes in forest type group Oak/Gum/Cypress/Elm/Ash/Cottonwood within wood pellet plant procurement areas over three periods: 2006-2009, 2009-2012, 2006-2012, in the Southeastern US (top), coastal states of the Southeastern US (middle) and interior states of the Southeastern US (bottom). Estimation of forest attributes carbon in organic soils and average annual harvest removals of live trees cannot be derived for concentric circles using FIA database by species group

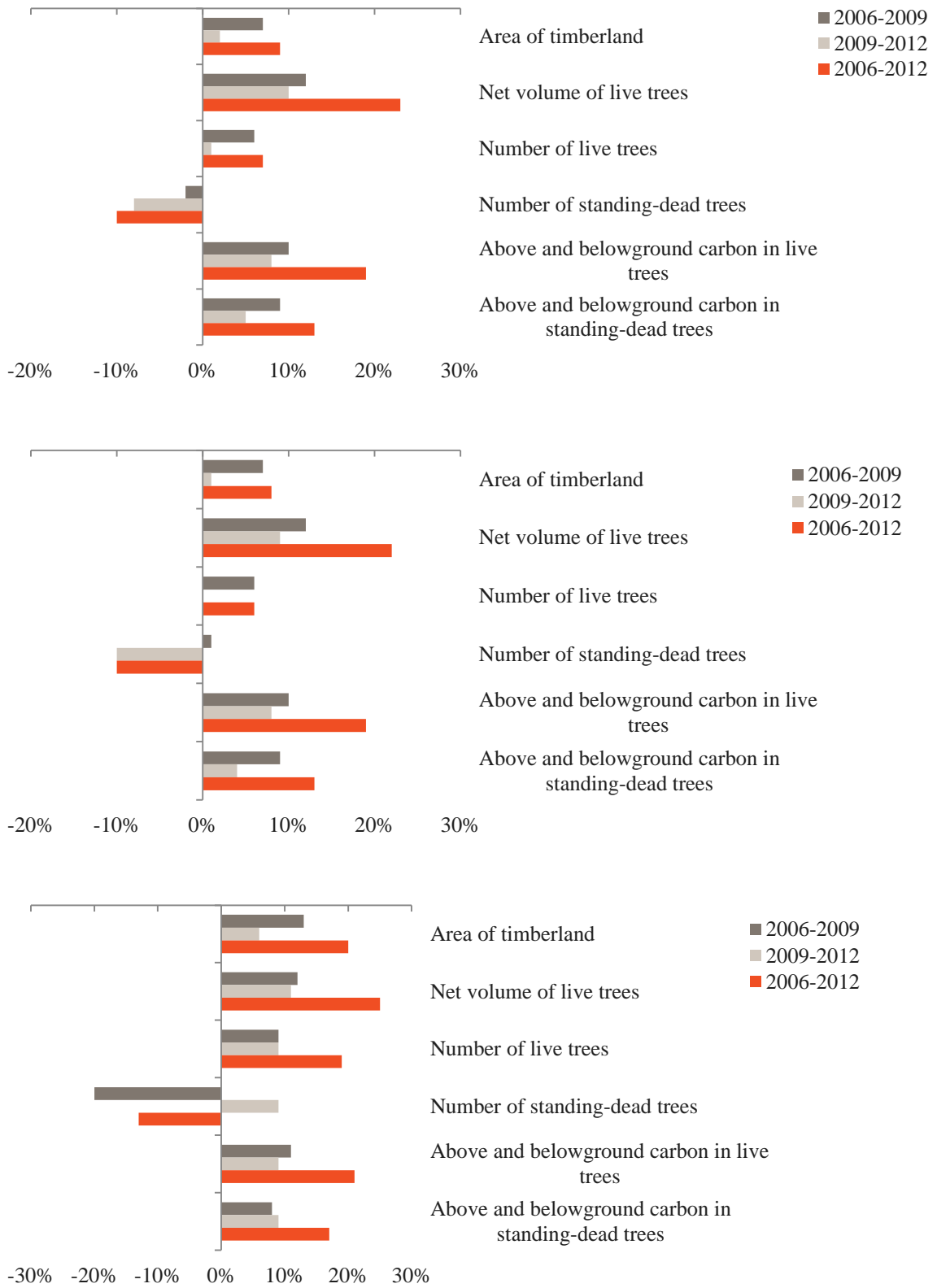
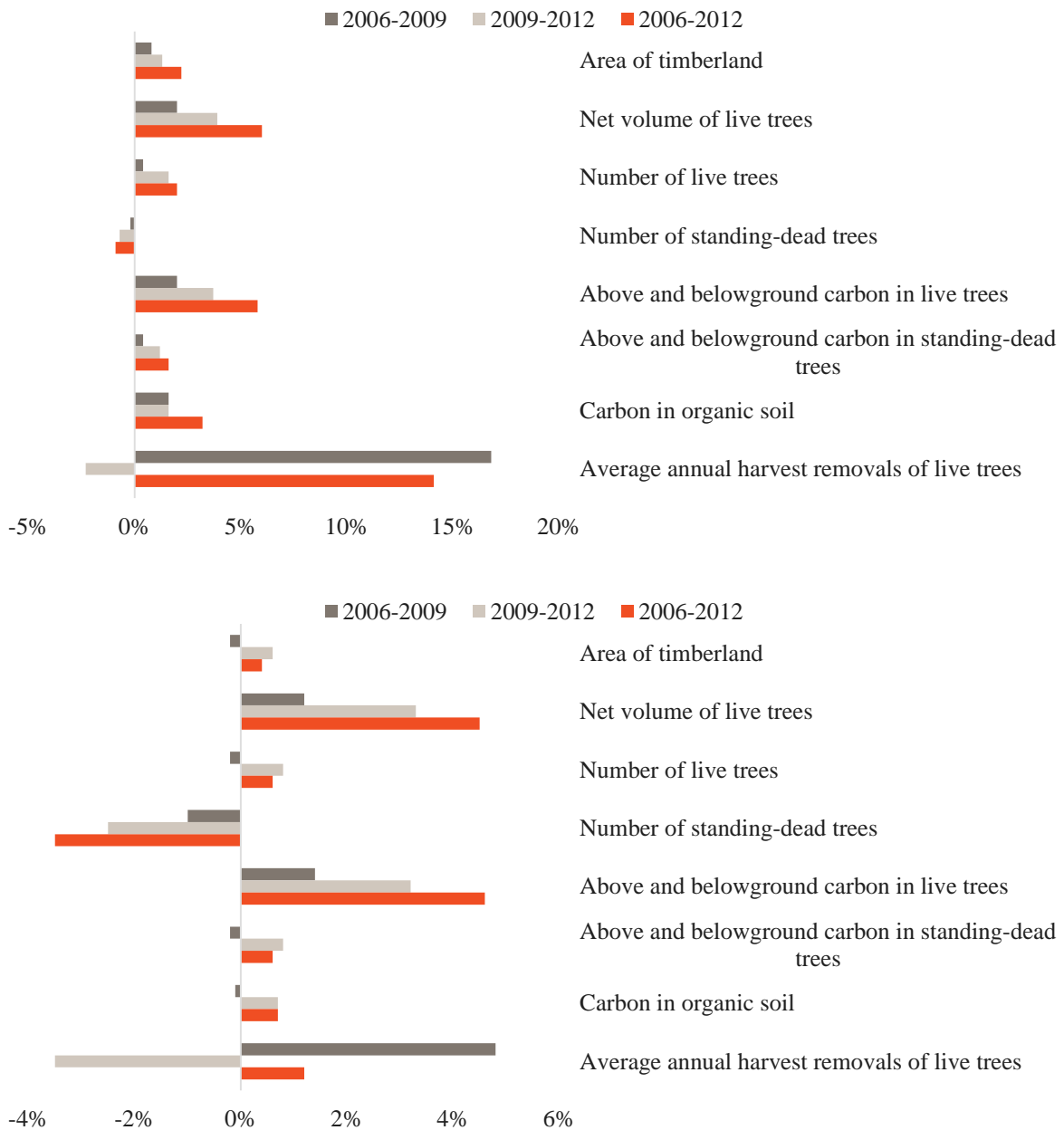


Figure 42. Percent changes in forest type group Loblolly / shortleaf pine group within wood pellet plant procurement areas over three periods: 2006-2009, 2009-2012, 2006-2012, in the Southeastern US (top), coastal states of the Southeastern US (middle) and interior states of the Southeastern US (bottom). Estimation of forest attributes carbon in organic soils and average annual harvest removals of live trees cannot be derived for concentric circles using FIA database by species group.

Figure 43 presents exploratory trends observed over the same time periods noted previously in the Northeastern region of the US. In the Northeastern region, as well as in the Southeastern region, preliminary evidence points to both seeing a decline in the number of live and standing-dead trees but neither had evidence of a decline in carbon pools found above and belowground. There was also a lower level of harvesting observed over the 2009-2012 period in the Northeastern region. These findings suggest no early differences between overall trends between the Southeastern and the counterfactual Northeastern region. This is an indication that the use of the Northeastern region as a counterfactual scenario might be appropriate for the estimation of marginal effects.



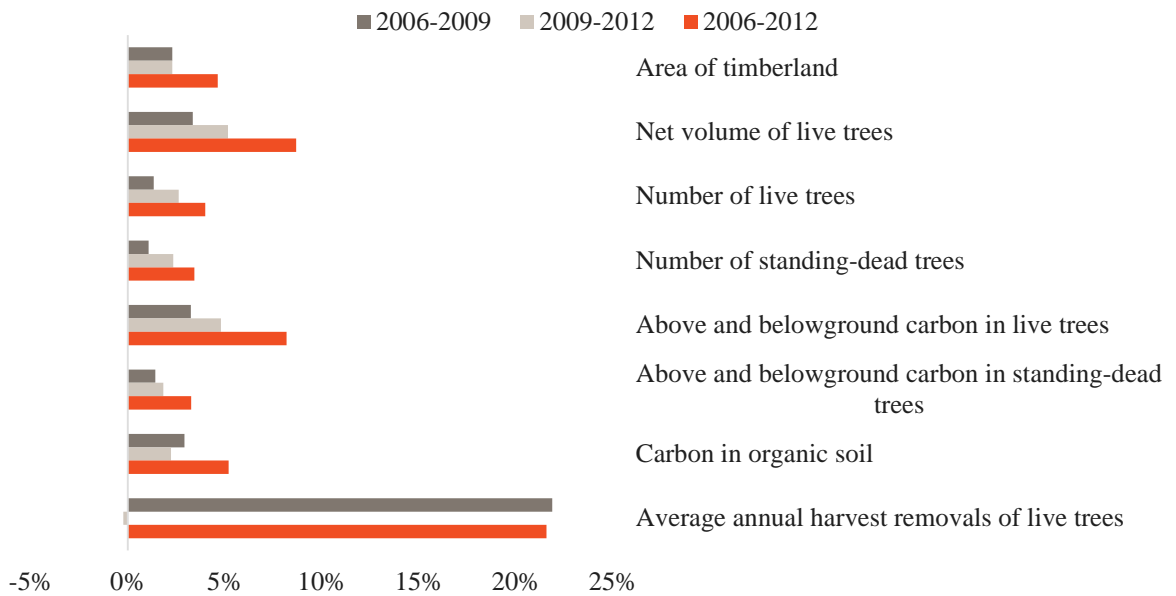


Figure 43. Estimated percent changes in selected FIA forest attributes over three periods: 2006-2009, 2009-2012, 2006-2012, in the Northeastern US (top), coastal states of the Northeastern US (middle) and interior states of the Northeastern US (bottom).

From the exploratory analysis, it can be derived that:

- Overall trends associated with the presence wood pellet manufacturing showed an increase in short-term expansion of timberland (though there was a small contraction over the longer 6-year period but the effect was negligible). Over the 2006-2012 period, there was small decrease in the number of live and standing dead trees within wood pellet plant procurement areas of the coastal Southeastern US states but no associated changes in carbon pools. There were higher levels of average annual harvest removals in the Southeastern US as compared to the Northeastern US over the period 2006-2012, with a particular sharper downturn in coastal Southeastern states over the 2009-2012 period.

Figure 44 shows results from the statistical analysis evaluating changes in selected forest attributes associated with changes in covariates - aimed to control for regional and local market conditions- to help discern net effects of Directive 2009/28/EC. It is important to note that the analyses were conducted for the periods of 2006-2009 and 2006-2012. The number of observations and the availability of counterfactual observations precluded the evaluation of the most recent 2009-2012 period. The FIA program periodically releases updated information on forest attributes that can be used in the future to further the current analysis to incorporate the most recent trends. Figure 44 identifies the estimated effects as denoted by Standardized Beta Coefficients that reflect on the magnitude of the effect (as denoted by the number of standard deviations explained by a given covariate coefficient) and corresponding standard errors. Exploration of the estimated direction, magnitude and significance of the covariates defining pellet operation in the Southeastern US coastal and interior states, and pellet capacity over 100,000 tonnes/year as those reflecting the marginal effects of greater EU

wood pellet demand suggest that after controlling for other factors included in the model:

- › Pellet plant procurement areas within Southeastern coastal states showed a slight decline in area of timberland in the short term 2006-2012 period, but no evidence of significant changes in the longer 2006-2012 term; fewer number of live trees across both time periods; a slight increase in the number of standing dead trees; no discernible changes in above and belowground carbon in live trees, nor in dead trees, nor in organic soil.
- › Procurement areas of wood pellet facilities with annual manufacturing capacity of at least 100 thousand tonnes showed a lower number of standing dead trees over both 2006-2012 and 2009-2012 periods. However, there was no reflection of any similarly associated manufacturing capacity effects on any of the carbon pools included in the study.

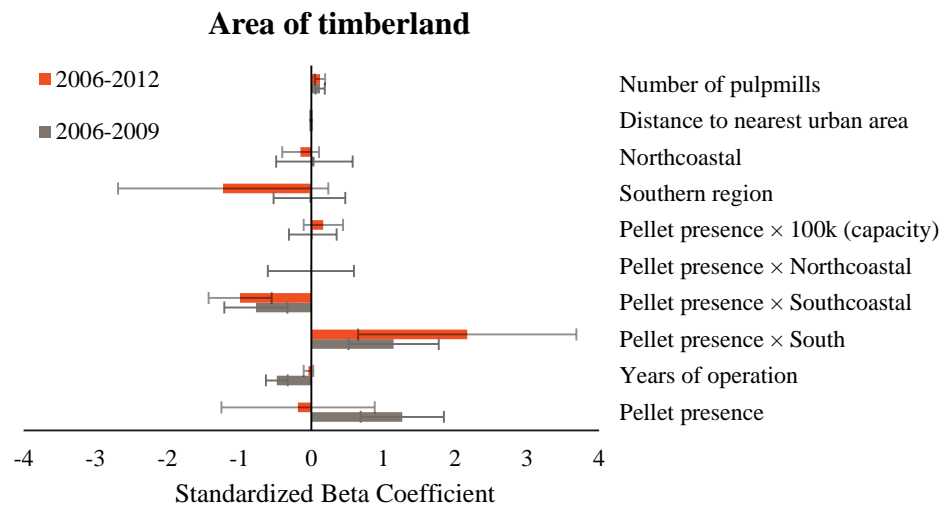
The collective evaluation of regional trends and the counterfactual statistical analysis suggest that the EU2020 'Directive 2009/28/EC' captured through greater demand for wood pellets from the Southeastern US and pellet plants of larger manufacturing capacity has not had a sizeable net impact on forest attributes of the region over the 2006-2012 period. Specifically:

- › Regional trends show that over the 2006-2012 period there was an expansion in timberland area. There is no indication of any discernible association concerning the effect of EU2020 targets and timberland area as captured by regional and pellet plant size covariates.
- › Regional trends point to an overall greater number of live trees. Particular effects associated to Southern coastal states and larger wood pellet capacity facilities suggest a comparatively smaller number of live trees in procurement areas of pellet plants of coastal states.
- › Regional trends suggest fewer number of standing dead trees across procurement areas of pellet plants in the Southeastern US, and to a lesser degree in the Northeastern US. However, no statistically significant effects were associated to procurement areas of pellets plants in South coastal states. On average, a fewer number of standing dead trees was discerned for procurement areas of wood pellet plants of at least 100 thousand tonnes annual manufacturing capacity.
- › Regional trends point to higher pools of carbon in above and belowground live trees, above and belowground standing dead trees and in organic soils. No discernible association was found between any of these carbon pools and wood pellet plant coastal location and manufacturing capacity of at least 100 thousand tons per year.

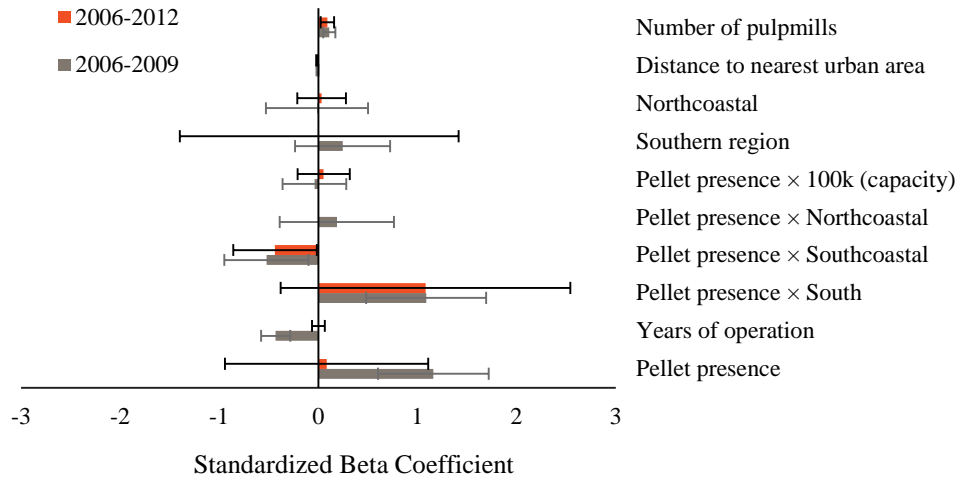
Regional trends and exploratory statistical analysis may draw a link between the number of dead trees and larger wood pellet plants over the time periods and the particular sampling and analytical tools used in this analysis. While per se a lower number of dead-trees does not imply negative impacts on forest conditions a long-

term decline in these variables may raise concerns particularly to the wildlife habitat services provided by forests. Other carbon pools were not significantly affected within the time period and sample areas included in this analysis that suggest that overall effects to-date have not significantly altered the carbon pools considered in this analysis.

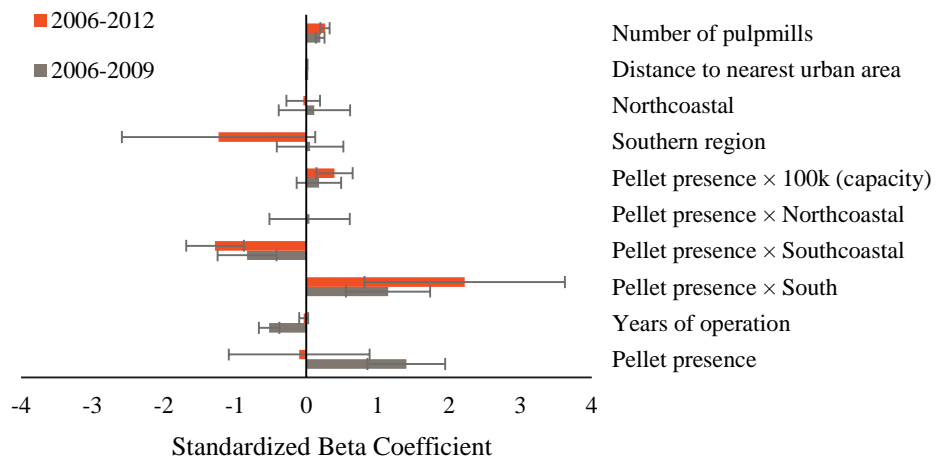
It is worth noting that a forthcoming study by the US DOE Oak Ridge National Laboratory (ORNL) using different sampling and analytical methods. Based on comments received following the Brussels workshop hosted by COWI and DG Environment in September 2015 during the workshop hosted by we learned from the ORNL Center for BioEnergy Sustainability that they are assessing measures of sustainability of all pellet mills that feed into the ports of Chesapeake and Savannah. Preliminary results from the FIA data as reported by ORNL Center for BioEnergy Sustainability indicate that increased wood pellet production since 2007 from these two fuelsheds (a) did not affect soil carbon, above-ground biomass, forest area, timberland area, large tree class stand area and (b) Savannah and Chesapeake fuelsheds had increased timberland area since 2007.



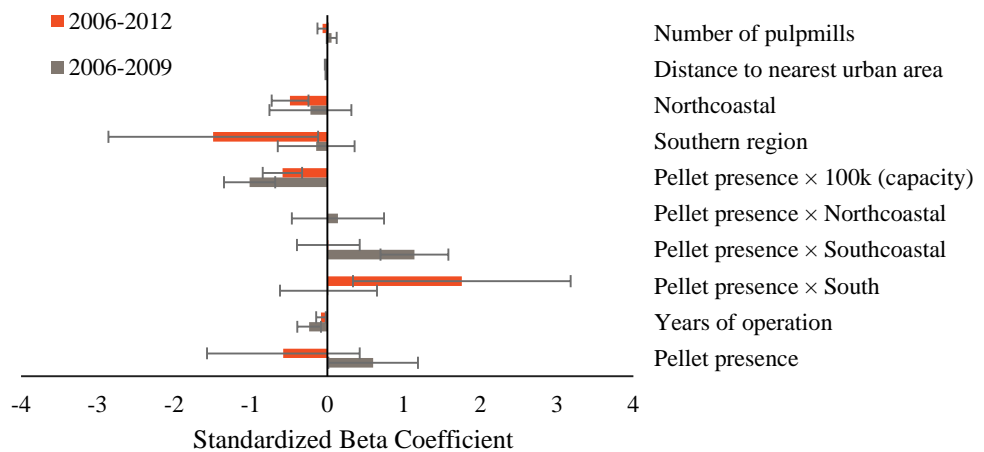
Net volume of live trees



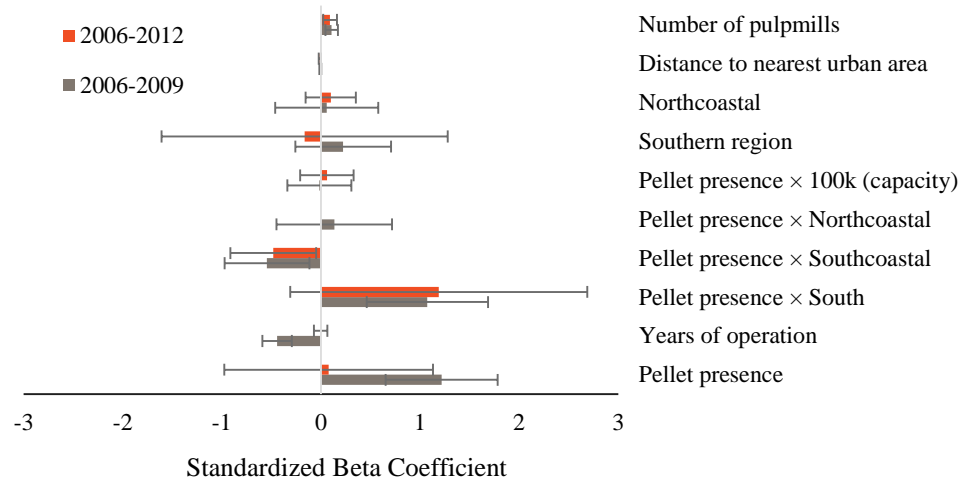
Number of live trees



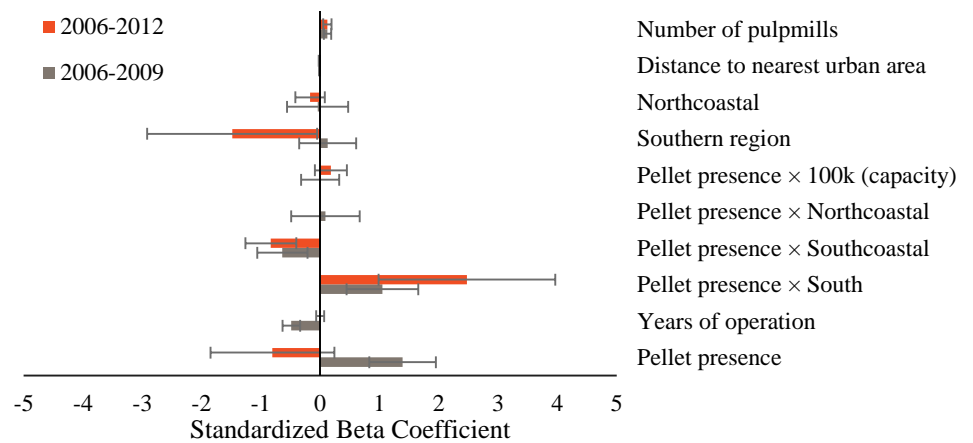
Number of standing dead trees



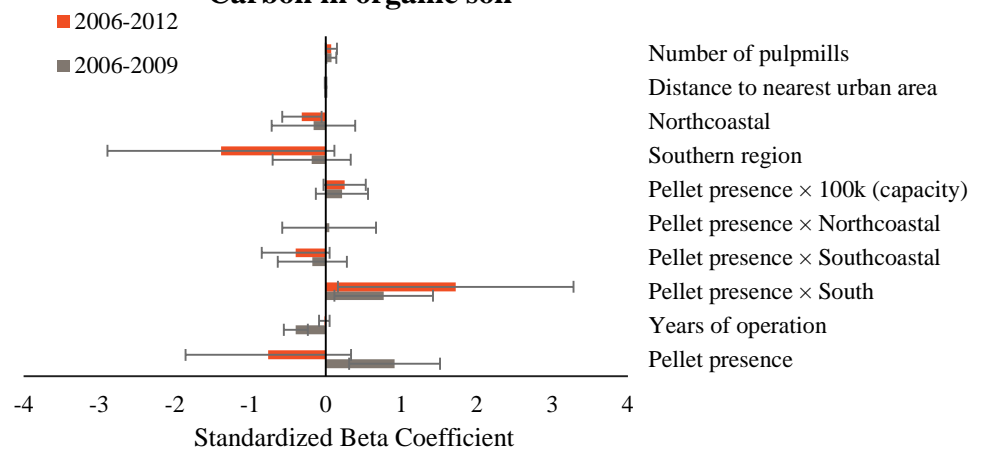
Above and belowground carbon in live trees



Above and belowground carbon in standing-dead trees



Carbon in organic soil



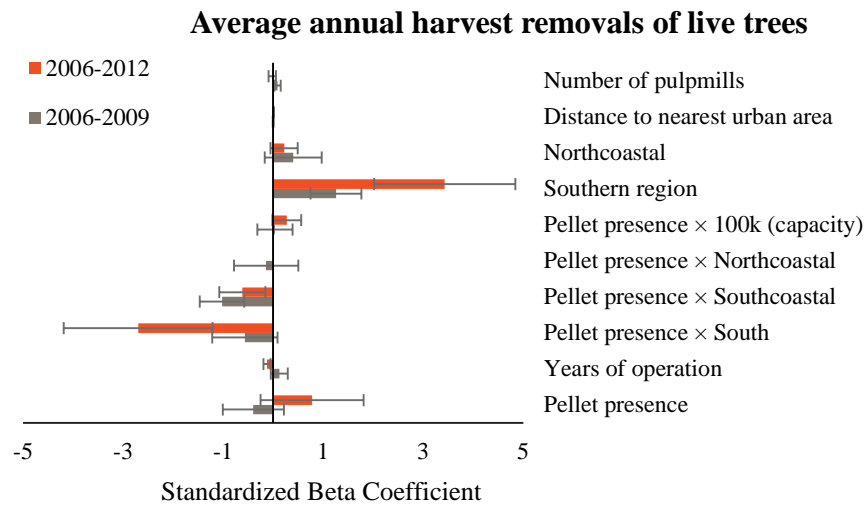


Figure 44. Results from statistical analysis of changes in selected US forest attributes as explained by model covariates to help discern net effects of EU2020 renewable energy targets.

7.2.2 Ex-ante evaluation of projected changes in forests of the Southeastern US

Abt et al. (2014) estimated the use of non-sawtimber (pulpwood, composites, and mill residues) based on information regarding expected future demand to project non-sawtimber bioenergy feedstock needs as a proportion of total non-sawtimber removals from 2011 through the year 2020 (Figure 45). The use of non-sawtimber as feedstock for both pellets and other bioenergy is shown in this figure and relies on perceptions of the future prices and availability of all eligible feedstocks. These projections include capacity for both pellet and non-pellet (e.g. generation of bioenergy including heat and power) production. In the year 2011, about 5% of all non-sawtimber removals were used to generate bioenergy of which about half was used to manufacture pellets in the Southeastern US. By 2013, the overall demand doubled in relative terms to about 10% almost equally split between pellet and non-pellet bioenergy. The share of non-sawtimber removals used to manufacture pellets sharply increases in their projections to reach 20% by the year 2017 and is projected to level off thereafter. Abt et al. (2014) projections suggest that pulpwood from softwoods, and from hardwoods in a smaller scale, will very likely have to be procured in addition to mill residues in order to meet the demand from wood pellet manufacturers.

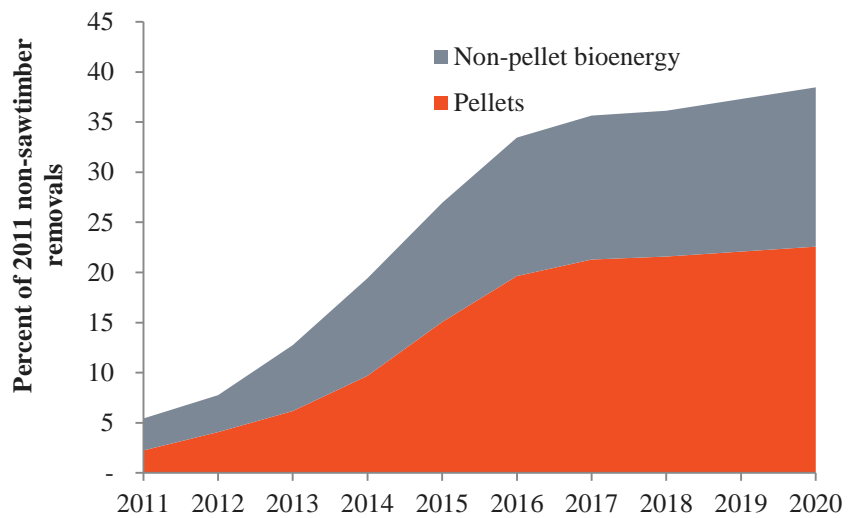


Figure 45. Bioenergy capacity estimated for 2011-2013 and projected through 2020 as a percent of total 2011 timber product output non-sawtimber removals in the Southeastern US. Source: Adapted from Abt et al. (2014).

The increase in expected demand for wood pellets and associated effects on timberland area was projected by Abt et al. (2014) through the year 2040. Their analysis included a baseline scenario in which bioenergy demand does not materialize but there is a recovery in the domestic US market, particularly in the house construction sector that increases timber rents over an assumed flat agricultural rent baseline. This projection is the baseline against which greater demand for non-sawtimber for pellet production, i.e. bioenergy scenario, is compared with.

Figure 46 reproduces Abt et al. (2014) projections of timberland area for the baseline and bioenergy scenarios. Simulations included only the Coastal Plain and Piedmont, areas where marginal agriculture and pine plantations historically compete. Projections distinguish between timberland classified as either pine plantations or natural forests. Timberland area totalled 44.6 million ha (30.5 million ha in natural forests and 14.1 million ha in pine plantations) in 2010. In both scenarios the total area of timberland is expected to contract by the year 2040. However, the extent of the loss in overall timberland area is more pronounced in the baseline scenario where it is projected to reach 40.8 million ha, as compared to the bioenergy one where total timberland area is projected to decline to 42.3 million ha, by 2040.

The distinction between a historic baseline and a bioenergy scenario suggests that, driven by greater demand for wood energy, pine plantation area increases over time (by as much as 3 million ha by 2025 over the baseline scenario) although this estimated net increase in pine plantation over historic trends almost halves by 2040 to 1.8 million ha. Such substantial changes in planted pine area are primarily driven by their sensitivity to market signals – planted pine is twice as sensitive to price changes as natural timberland (inclusive of natural pine, oak-pine, and upland

hardwood stands). Most of the expansion in pine timberland area is expected to come from the conversion of marginal agricultural lands and some from natural stands. By the year 2040 planted pine area is expected to account for 34% of the all timberlands within the projected areas in the bioenergy scenario, up from 31% in the baseline projections.

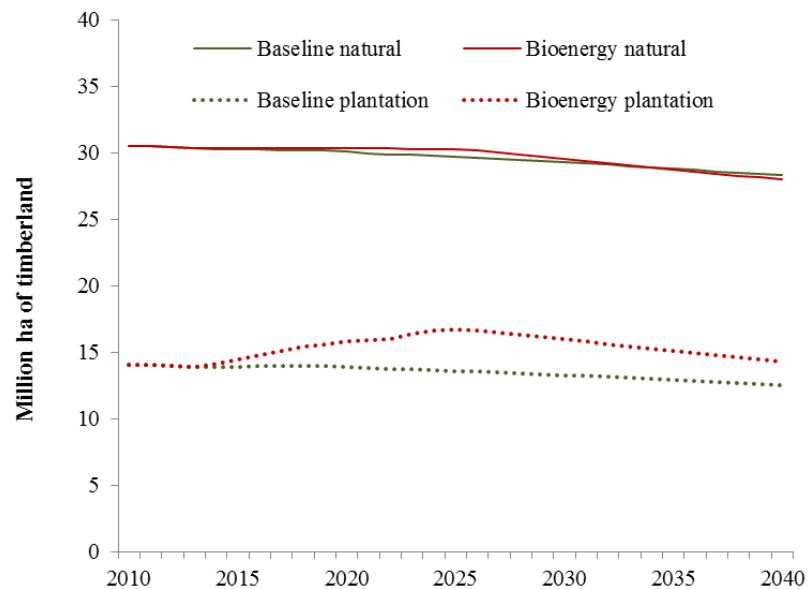


Figure 46. Projected timberland area in the U.S. Coastal South distinguishing between pine plantations and natural forest for both the baseline and bioenergy scenarios, 2010-2040. Source: Abt et al. (2014).

In the case of natural timberlands, greater demand by the wood energy industry is associated with an initial increase in hardwood area. Abt et al. (2014) projections suggest that compared to the baseline scenario bioenergy projections yield a net expansion in natural timberland of nearly half-a-million ha by the year 2025 although this trend reverts to a net loss of some 290 thousand ha by 2040. Changes in natural timberland are not expected to be as sizable as in the case of pine plantation due to the fact that these not as price sensitive. Plausible explanations for the initial expansion of natural forests in the bioenergy scenario are the concentration of bioenergy fibre supply within more productive and efficient pine plantation areas and reversion to natural forest stand conditions away from marginal agricultural lands. Some natural forest land is likely to be lost to pine plantations, but this loss of natural forests to plantation acreage is largely offset by the reduction in loss to agriculture over the length of the projections (Abt et al. 2014). In relative terms, by the year 2040 natural forests would account for 66% of all timberland in the area projected, down from 69% in the baseline scenario.

Collectively, Abt et al. (2014) suggest that total timberland area is expected to decline regardless of scenario, but extent of losses would be less pronounced in a bioenergy scenario. Compared with historic trends, a scenario with greater demand for wood energy sees overall pine area expansion, primarily driven by planted pine, with some net losses in natural pine stands occurring farther into the future. The sizeable expansion in planted pine timberland area is a response to increases in non-sawtimber prices as demand for wood energy fibres is expected to outpace supply. For instance, projections by Abt et al. (2014) suggest that an indexed non-sawtimber price (index =100 in baseline year 2010) could more than doubled to reach a value of 222 with increased demand for wood energy fibres in year 2025 - while in the absence of bioenergy demand historic trends point to a price index of 103 in the Southeastern US. Corresponding indexed price differences for hardwood non-sawtimber between historic and bioenergy scenarios are less pronounced which is partly reflected in Figure 46. Area of timberland classified as natural is expected to contract in both historic and bioenergy scenarios and although there is an initial net expansion of natural timberland associated with the bioenergy scenario by the year 2024 those gains have reverted and some net losses might be experienced by 2040.

The SRTS projections by Abt et al. (2014) suggest that both a historic baseline and a bioenergy scenario point to an expected contraction in forested areas within their study area, primarily driven by market pressures from other land uses, including urbanization. However, the expected decline in forests under the wood pellet demand scenario is less evident than under historic trends. This is partly due to expected increases in non-sawtimber prices under a bioenergy scenario. There are differences in the expected shares of age classes with a slight shift toward older age groups in the wood pellet scenario as forest plantations established in the early years mature. These trends are depicted on Figure 47 and Figure 48 that show projected changes in timberland area distinguishing age classes for planted and natural pines and lowland hardwood, upland hardwoods and mixed pine/hardwoods.

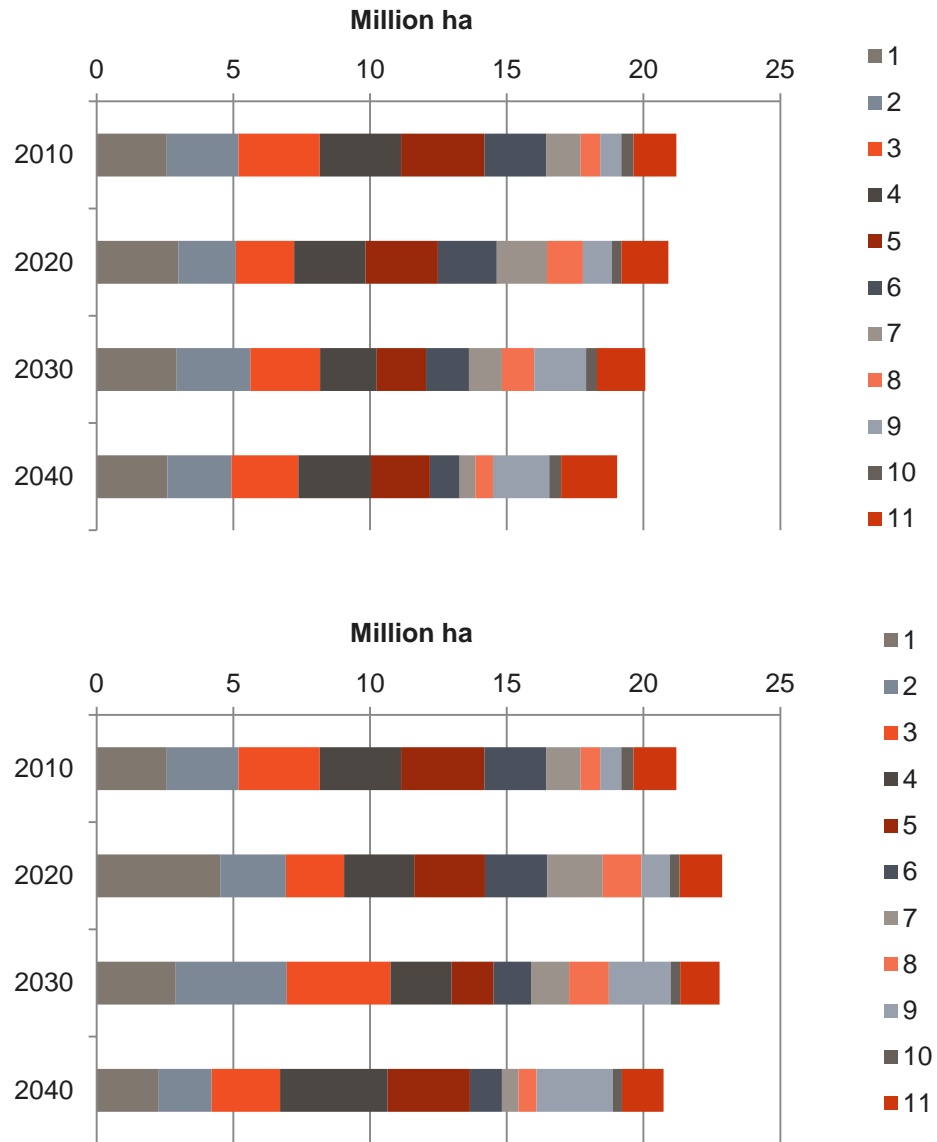


Figure 47. Projected changes in forest area distinguishing age classes for planted and natural pines in the Southeastern US under a baseline historic scenario (top) and estimated growth in wood pellet demand (bottom). Age classes by 5-year groups (e.g. clas1 =0-5 years, 2=6,10, ...11≥50 years). Source: Abt et al. (2014).

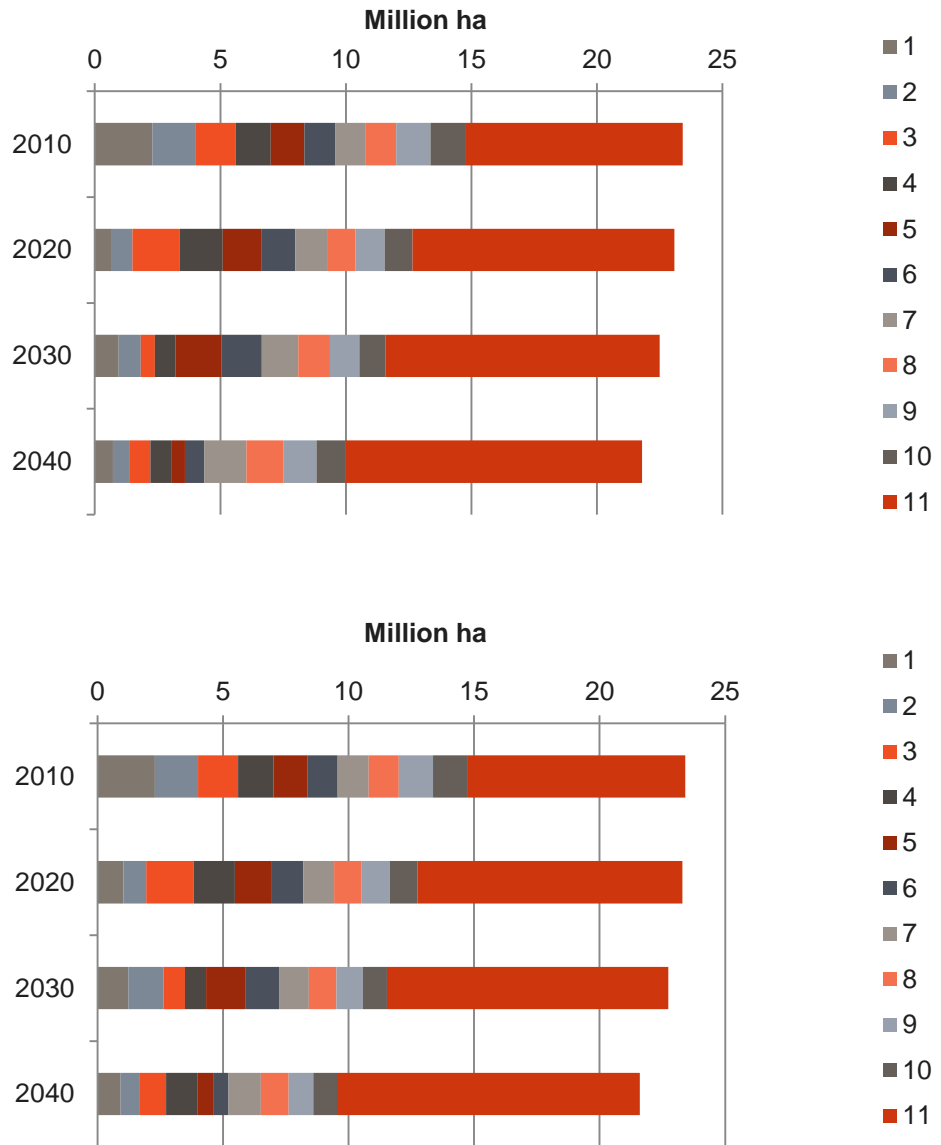


Figure 48. Projected changes in forest area distinguishing age classes for lowland hardwood, upland hardwoods and mixed pine/hardwoods in the Southeastern US under a baseline historic scenario (top) and estimated growth in wood pellet demand (bottom). Age classes by 5-year groups (e.g. clas1 =0-5 years, 2=6,10, ...11≥50 years). Source: Abt et al. (2014).

Galik & Abt (2015) used the SRTS to project the likely effects of additional bioenergy developments (mainly associated to EU demand for biomass) on US Southern forest markets. Their analysis included several proxies to account for the adoption of sustainability guidelines banning biomass harvesting from (a) protected areas, (b) areas of high biodiversity and conservation value, and (c) undrained peatlands or wetlands. Regardless of whether sustainability guidelines are applied in the projections, Galik & Abt (2015) found increased forest removals, a lower degree of contraction in forest area, and little change in forest inventory as compared to a baseline scenario. Projections suggest that estimated additional pellet demand was found to have a small relative impact on regional forest product prices, removals, and inventories, with more discernible pressure effect pulpwood

prices. The price of pine pulpwood increases approximately up to 50% over the baseline historic conditions across sustainability guidelines and unrestricted procurement scenarios. Galik & Abt (2015) expect annual gains in forest carbon in most years of the analysis but there is ample variability from year to year. Pellet GHG balance shows significant annual change and is attributable to the complexity of the underlying forest landscape. They stress that the incremental effect of adopting sustainability guidelines on forest carbon and pellet GHG balance is difficult to discern, but based on their findings suggest that guidelines could be steering production away from sensitive forest types that are inherently less responsive to changing market conditions.

It is worth noting some of the limitations intrinsic to the type of market projections conducted by Abt et al., (2014) or Galik & Abt (2015), among others. A significant limiting factor is that bioenergy and pellet markets are new markets, and little empirical research has been done on them, so the models largely relied on assumptions from research for other product types. For example, they rely on market responsiveness to price changes elicited from sawtimber and pulpwood markets and not demand or supply price elasticities for bioenergy. Price signals are expected to encourage a net expansion in pine timberland area (mostly from agricultural lands of marginal value) but there is no absolute certainty that such a shift in land re-allocation will materialized. A second limiting factor is that policies are not static, both domestically and internationally. For instance, the adoption of proposed regulations by the US EPA (e.g. Clean Power Plan for existing power plants, clean-air standards for residential woodstoves and pellet stoves) can have significant effects on domestic demand for bioenergy and wood pellets in particular (US EPA, 2014; 2015). However, whether any of these policies will have a sizeable deterrent or competing effect on US pellet export demand is unknown.

Furthermore, household preferences and competing energy costs will also influence US domestic demand for wood pellets (Song et al., 2012) that could complement or compete with European demand in the future. Although not reflected in recent nationwide US statistics, wood energy has reportedly gained popularity as a home heating option in many areas of the US. The increase is most notable in the Northeast where data from the US Residential Energy Consumption survey suggest at least a 50% increase in use in the number of households that use wood as their main heating source from 2005 to 2012 (Berry, 2014). External factors, such as weather, will be important drivers behind US domestic wood pellet demand. Cold winters in the US coupled with an increasing demand for wood pellets seem to be already creating price pressures that could support greater domestic production. RISI (2015) reports pellet-grade softwood prices showing no change in 2014 over 2013 in the US Pacific Northwest but year-on changes in prices (\$/green tonne delivered) ranging from 7% (South Atlantic, South Central) to 11% Northeast.

There were larger changes of US hardwood pellet-grade wood across the US with year-on changes of 7% in the South Atlantic and South Central regions, 16% in the Lake States and 20% in the Northeast. The highest prices estimated by RISI were in the Northeast at \$40 and \$48 per green tonne of delivered pellet-grade wood in the last quarter of 2014. Finally, as wood pellets become a globally traded commodity it is likely that the emergence and/or competitiveness of current/new

wood pellet suppliers (e.g. Canada and Brazil) and growing markets (e.g. Japan Republic of Korea) will affect US wood pellet markets.

Summary highlights:

- › Evaluation of the effects of greater wood pellet demand on forests of the Southeast US were explored based on *ex post* and *ex ante* analyses. The *ex post* analysis focused on changes in forest attributes over the 2006-2012 period. The *ex-ante* analysis included projections for potential changes from 2010 through 2040. Analyses were based on several data sources with a common source being the FIA database.
- › Findings are deemed exploratory due to the short time period over which the wood pellet industry has emerged in the US, imperfect data, uncertainty in future market conditions directly and indirectly affecting wood pellet manufacturing among other limitations inherent to counterfactual assessments and projected future scenarios.
- › The *ex post* analysis explored changes in selected forest attributes between 2006-2012, 2006-2009 and 2009-2012. Time periods were evaluated to gauge changes in short- and mid-term conditions. Forest attributes derived from the FIA database included: area of timberland, net volume of live trees, number of live trees, number of standing-dead trees, above and belowground carbon in live trees, above and belowground carbon in standing-dead trees, carbon in organic soil, and average annual harvest removals of live trees.
- › Forest attributes for the *ex post* analysis were estimated within procurement areas of wood pellet plants defined as concentric circles of 80.47km radius. Southeastern regional trends within procurement areas of wood pellet plants in the Southeast US were compared to those in the Northeastern US, which was used as a proxy for a counterfactual scenario, to discern differences likely associated to the EU Directive 2009/28/EC.
- › The assessment of impacts using a proxy counterfactual scenario is inherently limited by the limited comparability of the regions selected, changes over defined time periods, the inability to elicit long term impacts or effects occurring beyond defined procurement areas, imperfect and incomplete information that prevent unequivocal determination of causation. The use of *ex ante* regional projections helped address some of these limitations but projections themselves are limited in their ability to predict conditions for new markets with unknown future domestic, European and global markets and land prices.
- › Results suggest no sizeable changes in overall *ex post* trends regarding timberland area between the Southeastern US and the counterfactual, Northeastern region. However, there was a minimum decline in timberland area associated with wood pellet plants located within Southeastern coastal states over a short time three-year period. Collectively, results of *ex post*

forest structure suggest that within all wood pellet plant procurement concentric circles, whether in the Southeast or Northeast, there was indication of a decline in the number of standing-dead trees but no detectable lower level in above and belowground carbon in standing-dead trees. Marginal effects associated with pellet plants of capacity of at least 100 thousand tonnes per year and fewer number of standing dead trees was found. Pellet plants of these characteristics are the most likely to be influenced by EU2020 targets. There were no discernible marginal effects on carbon from pools including above and belowground carbon in live and dead trees, nor changes in carbon in organic soil.

- › *Ex ante* projections through 2040 suggest the financial incentives created by demand from wood pellet facilities will likely reduce the losses of forest acreage compared with a baseline scenario, although timberland area in the US South is expected to decline in the future. Projections suggest likely net growth, over baseline trend, in timberland area particularly of planted pines, with some losses of natural pine stands. In the case of all hardwoods, these are not very sensitive to market changes although there might be contraction in acreage. Price pressures can be expected on potential other wood fibres, including pulpwood, and will likely be affected by levels of domestic US wood energy consumption (likely from an expanding residential sector), among other factors.
- › Net expansion in softwood timberlands foreseen to come largely from marginal agricultural lands. While plausible, such market responses are not certain and might deserve close monitoring. Future land allocation and the preservation of timberland area, whether pines or hardwoods, will be a function of complex and interacting factors, of which European policy will be just one of them.

8 Identification of risks and appropriate EU policy options

The preceding chapters analyse how increased EU demand for biomass for energy sourced from the southeast US may have environmental implications. These could in turn compromise certain policy objectives guiding EU policies, and thereby pose a risk to the achievement of these objectives.

Chapter 6 identified four concrete effects and investigated the literature for evidence supporting or disapproving the effects. In chapter 7, *ex-ante* and *ex-post* assessment were used to more explicitly explore the net effects of EU induced demand at US wood biomass markets and background demand, be it from domestic or foreign parties.

Historic baseline scenario and justification of EU action

In chapter 8, the effects identified in chapter 6 will be combined with the modelling from chapter 7 on the effect of the marginal EU demand and assessed against the relevant policy objectives. This serves the purpose of establishing both a historic baseline scenario (in absence of EU action) and to clarify whether the combined signal is sufficiently strong (magnitude and likelihood) to justify EU action.

8.1 Methodology and structure

This chapter will first identify EU policy objectives, expressed in international agreements or domestic policies by the EU that are relevant to production and use of biomass for energy. These objectives will then be linked to the environmental implications (effects) identified in the previous sections and assessed for magnitude and probability. This will allow identifying which objectives are most urgently at risk and therefore relevant options for possible EU action. In the next step, the risks will be further characterized in order to better qualify what type of action could be envisioned to mitigate the risk, if any. Based on the characterization, a number of options for EU action will be developed and described for effectiveness of addressing the problem(s), expert judgment of associated cost, administrative burden, legal obstacles and not least undesirable side effects. In summary, this analysis is conducted in three steps:

- 1 Establish policy objectives

- 2 Investigate risk(s) to the achievement of the objectives
- 3 Identify intervention tools that can address the risks

The link between policy objectives, environmental indicators and effects, and the identified policy risks is tested using the below analytical flow.

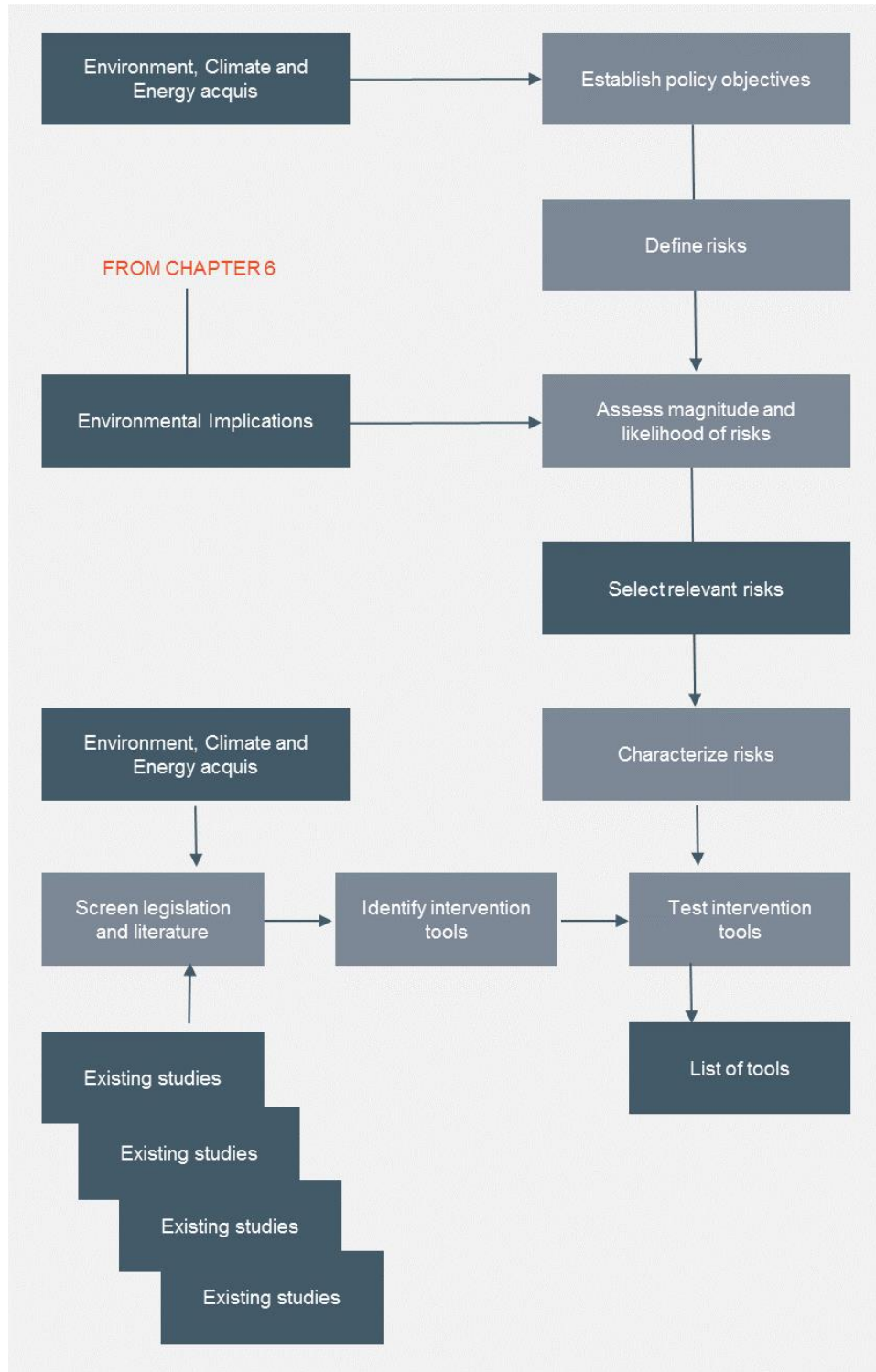


Figure 49. Flow for analysis of link between objectives, environmental implication indicators, effects and the identification of potential policy risks.

8.2 Step 1: EU policy objectives

Identifying EU policy objectives

Globally, the European Union has committed to a number of treaties and conventions that concern the environment and natural resources. They include biodiversity (CBD), climate change (NFCCC) forests (UNFF) and trade in endangered species (CITES). Through these commitments, the Union has taken a leading role in the global community, when it comes to caring for our natural capital. Regionally, the sustainable management of European forests is supported by and incorporated in a variety of community strategies and policies, including the climate and energy package of 2009 (EU-ETS, ESD, RED, FQD¹¹¹), the EU Forest Strategy 2013 (COM(2013)659), the EU Biodiversity Strategy to 2020 (COM(2011)244) and the General Union Environmental Action Programme to 2020 (7th EAP, Decision 1386/2013/EU). If current or increased EU demand for biomass for energy is found to be inconsistent with its objectives or have negative environmental implications in third countries, this could in worst case imperil the reputation of the EU as an actor in global environmental policy. The risk that one or more global environmental objectives could not be achieved, directly or indirectly due to EU, action would become a reputational risk for the EU, and would warrant EU action. This section explore and identify relevant EU objectives.

International or global policy objectives

As parties to several conventions and member of a number of international organizations with relevance for forests and trade in forest species or products, the EU has committed to support the achievement of the objectives behind these, see Table 8-1 below.

Table 8-1. Matching International commitments and EU policies with objectives.

| Treaty/Agreement/Convention/Organization | Objectives with forest and bioenergy relevance | EU | Objective* |
|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------|
| <i>Environmental</i> | | | |
| United Nations Convention on Biological Diversity (UNCBD) | Aichi target: At least halve and where feasible bring close to zero the rate of loss of natural habitats including forests. | 7th EAP and the Biodiversity Strategy | 1) Protect and improve biodiversity |
| The Convention on International Trade in Endangered Species of wild fauna and flora (CITES) | Biodiversity conservation - regulates and protects specific plant and timber species (provided in the Annexes to the Convention) in order to protect against over-exploitation through international trade | | |
| United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol | LULUCF and REDD+: Limit emissions from forests management, forest degradation and deforestation (Mitigation) REDD+: Enhance resilience of forests to changing climate (Adaptation) | EU Climate and Energy Package for 2020. LULUCF Decision RE Directive | 4) Obtain GHG benefits from the use of biomass for energy |

¹¹¹ ESD, Effort Sharing Decision; RED, Renewable Energy Directive; FQD, Fuel Qualitative Directive

| | | | |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| | | (Any 2030 equivalents of both) | |
| International Tropical Timber Organization (ITTO) | (cooperation, no commitment) | Forest Strategy FLEGT Timber Regulation Forest(ry) measures under CAP Pillar II Green Public Procurement | 2) Halt deforestation and degradation |
| United Nations Forum on Forests | (dialogue, no commitment) | | |
| REDD+ | Reducing Emissions from Deforestation and Forest Degradation (REDD) seeks to create a financial value for the carbon stored in forests, offering incentives to reduce emissions from forested lands. "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks (UNREDD, 2015) | | |
| 2014 UN New York Declaration of Forests (concerning drivers of deforestation) | The New York Declaration on Forests is a non-legally binding political declaration agreed upon at the UN Climate Summit in New York, US, in September 2014. It seeks to cut natural forest loss in half by 2020, and strive to end it by 2030 (UN GA, 2014) | | |
| United Nations Sustainable Development Goals (UNSDG) | Goal 13: Take urgent action to combat climate change and its impacts Target 15.1: Protect restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally. Target 15.b: Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation. | | 4) Obtain GHG benefits from the use of biomass for energy 2) Halt deforestation and degradation |
| United Nations Sustainable Development Goals (UNSDG) | Target 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services Target 7.2: By 2030, increase substantially the share of renewable energy in the global energy mix Target 7.3: By 2030, double the global rate of improvement in energy efficiency Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation Target 12.1: Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries Target 12.2: By 2030, achieve the sustainable management and efficient use of natural resources Target 12.5: By 2030, substantially reduce waste generation through prevention, reduction, recycling | Renewable Energy Directive Roadmap to Resource Efficient Europe Low Carbon Strategy Bio-economy Strategy Circular Economy package (COM(2015)614/2) and relevant waste legislation | 3) Ensure optimal use of wood resources |

| | | |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| | <p>and reuse.</p> <p>Target 12.6: Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle.</p> <p>Target 12.7: Promote public procurement practices that are sustainable, in accordance with national policies and priorities.</p> | |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

**Take note, that objectives are author's formulations, and cannot be found in the respective strategies, agreements, decision etc.*

Objectives in the EU acquis

A number of EU policies implement or support international commitments:

For example, the EU 7th EAP and the corresponding Biodiversity Strategy for 2020, that support the Aichi Targets and the UNCBD. Likewise, the European Union Emissions Trading Scheme (EU ETS), the Effort Sharing Decision, and a host of other policies and strategies support the UNFCCC and the achievement of the reduction commitment under the Kyoto Protocol. The Renewable Energy Directive also identifies emission reductions among its main objectives and is based on the environmental Article of the EU Treaty.

Following from the international policy objectives given under UNCBD, UNFCCC, CITES, ITTO and UNSDG, and the EU policy objectives outlined in the EU Forest Strategy, the Biodiversity Strategy to 2020 and the 7th EAP, a number of EU policy objectives with relevance for solid biomass used for energy purposes can be identified¹¹².

Objective 1: Protect and Improve biodiversity

The European Union is Party to the United Nations Convention on Biological Diversity (CBD) of 1992 ([CDB](#), 2015). Under the CBD, the EU has signed the CBD Strategic Plan for Biodiversity 2011-2020 ([CBD, 2010](#)) that includes the 20 "Aichi Targets" that seek to

- 1 address the underlying causes of biodiversity loss,
- 2 reduce the direct pressures on biodiversity,
- 3 improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity,
- 4 enhance the benefits to all from biodiversity and ecosystem services, and

The EU and the United Nations Convention on Biological Diversity (CBD)

¹¹² The order of the objectives as they are presented in the below sections does not reflect any order of importance. The objectives has been ordered according to their respective *acquis*: The first two are key policy areas of the contracting DG for this study, the third is shared between the contracting DG and other DGs, whereas the fourth *acquis* (on GHG) is the responsibility of other DGs.

- 5 enhance implementation through participatory planning, knowledge management and capacity building.

The EU Biodiversity Strategy to 2020

The framework for EU action in order to meet the commitments under the CBD Strategic Plan has been laid down in the EU Biodiversity Strategy to 2020 ([COM\(2011\)244](#)). As an integral part of the EU 2020 Strategy ([COM\(2010\)2020](#)) and the Resource Efficient Europe initiative ([COM\(2011\)21](#)), the strategy aims to reverse biodiversity loss and speed up the transition of the EU towards a resource efficient and green economy. The 2020 Biodiversity Strategy includes six targets that each seeks to address a specific issue ([COM\(2011\)244](#)). In this context, the most relevant are:

- › Target 2: Maintain and Restore Ecosystems and their Services
- › Target 3: Increase the Contribution of Agriculture and Forestry to Maintaining and Enhancing Biodiversity
- › Target 6: Help Avert Global Biodiversity Loss

Each of these targets includes a set of actions that responds to the challenge(s) addressed by the target. In this context, especially Action 17 that seeks to "Reduce indirect drivers of biodiversity loss" is relevant, as it commits the EU to "take measures (which may include demand and/or supply side measures) to reduce the biodiversity impacts of EU consumption patterns, particularly for resources that have significant negative effects on biodiversity" ([COM\(2011\)244](#) Annex). This also aligns with the horizontal policy objective of the 7th EAP that seeks to "increase the Union's effectiveness in addressing international environmental and climate-related challenges" ([Decision 1386/2013/EU](#), art. 2(i)). Even more tangible, as part of the Aichi Targets, the Parties, including the EU, agreed to "at least halve and where feasible bring close to zero the rate of loss of natural habitats including forests." ([COM\(2008\)645](#)).

Therefore, if EU policies and incentives thus leads to loss of forest biodiversity in – or outside – of the Union, then these policies or incentives challenges the achievement of the ambitions outlined above.

Objective 2: Halt deforestation and forest degradation

Clearing of forest lands lead to loss of all ecosystem services, including habitat functions, GHG storage and livelihoods. While the deforestation is closely linked to biodiversity and climate change, it has been established as a discrete objective in international and Union policies over the years.

The EU and forest policy in international arenas

The Treaties for the European Union make no provision for a common forest policy. However, through its policies the EU seek to foster sustainable forest management in EU Member States and a number of EU policies and initiatives within various sectors affects forests. On behalf of the EU, the Commission take part in a number of agreements and processes, or work with the Presidency to ensure a common EU position on the topic at stake, in arenas such as the United Nations Forum on Forests, the International Tropical Timber Organization, and the

Timber Committee of the United Nations Economic Commission for Europe. With this engagement, the EU and its Member States is taking up a leading role in protection of forests and forestland, inside and outside of the Union itself.

In 1998, the Council adopted the EU Forestry Strategy ([1999/C56/01](#)), which was reviewed in 2005, and a Forest Action Plan was presented in 2006 ([COM\(2006\)302](#), [SEC\(2006\)748](#)). In 2013, the Commission adopted the new EU Forest Strategy ([COM\(2013\)659](#)), accompanied by a Staff Working Document ([SWD\(2013\)342](#)), which highlights that forests are important not only for rural development, but also for biodiversity, bioenergy and climate change mitigation. The Strategy also emphasizes that actions beyond forests and the impact of other policies on forests should be taken into account.

In its Communication on "Addressing the challenges of deforestation and forest degradation to tackle climate change and biodiversity loss" ([COM\(2008\)645](#)), the Commission stressed the need for the EU to "take a leading role to shape the global policy response to deforestation," underlining that "one of the main drivers of for deforestation is economic." It further stated that "a comprehensive policy on deforestation cannot disregard the demand side and the responsibility of consumers," noting that "certain internal and external EU policies can be used to help achieve the overall objective" of a reduction in deforestation of 50% by 2020 (compared to current (2008) levels).

Forests in the 7th EAP

More recently, the 7th EAP calls for: "assessing the environmental impact, in a global context, of Union consumption of food and non-food commodities and, if appropriate, developing policy proposals to address the findings of such assessments, and considering the development of a Union action plan on deforestation and forest degradation". For the purpose of this study, the wording of the EAP illustrate the understanding that the impact of EU policies driving EU demand for wood should be assessed for impact on forests outside of EU, and thus that EUs responsibility for addressing deforestation exceed its own territory.

To support the reduction of deforestation outside of the Union, the EU and its MS take part in the REDD+ initiative (Reducing Emissions from Deforestation and forest Degradation) and has initiated domestic activities, such as the Action Plan on Forest Law Enforcement, Governance and Trade (FLEGT) ([Council regulation 2173/2005](#)) ([Commission regulation 1024/2008](#), [Commission regulation 363/2012](#) and [Commission regulation 607/2012](#)). In 2013, the Timber Regulation came into force, which aim to ensure legality of all wood placed on the European Market. It has also undertaken a study to determine the impact of EU consumption on deforestation (DG ENV Technical Reports 2013/063 ([EC, 2013a](#)), 2013/064 ([EC, 2013b](#)), 2013/065 ([EC, 2013c](#))).

Objective 3: Ensure optimal use of wood-resources

The ecological footprint of the EU is significantly larger than its territory (WWF *Living Planet Report*, 2014); meaning that the EU is using far more resources than it produces itself. As mentioned under *GHG benefits*, the EU's use of fossil based resources result in a carbon footprint larger than the global average. This also applies to the EU's use of biomass resources for food, feed and energy. The

SOER 2015 report (EEA, 2015), explains how further socio-economic progress must rely on decreasing resource use, in what is called 'absolute decoupling' (p. 83). In short, the Europe of the future should "*do more with less*" (IVM et al., 2014). There are many ways to address this challenge, including increasing resource efficiency, promoting cascade use and circular economy, and substituting energy and carbon intensive resources with less intensive and possibly renewable alternatives.

The United Nations Sustainable Development Goals (SDGs) in the context of wood resources

The global community has grown to recognize that resources is expected to become increasingly scarce, while demand is expected to increase. The 17 recently endorsed 2015 UN Sustainable Development Goals ([UN, 2015](#)) reflect this recognition, in particular goals 7, 8, 12, 14 and 15, but is after all not binding. In the EU, a number of roadmaps, strategies, and staff working documents outline how different sectors or policy areas could address this use of resources. The Roadmap to a Resource Efficient Europe ([COM\(2011\)571](#)) outlines how Europe's economy can become sustainable by 2050, and is part of the Resource Efficiency Flagship ([COM\(2011\)21](#)) of the Europe 2020 Strategy. Under the flagship initiative, a number of proposals have been put forward. In relation to bioenergy and wood use, the most important of these include:

- › Energy 2020: A strategy for competitive, sustainable and secure energy ([COM\(2010\)639](#))
- › Low-carbon economy 2050 roadmap ([COM\(2011\)112](#))
- › Roadmap for a resource-efficient Europe ([COM\(2011\)571](#))
- › Energy Roadmap 2050 ([COM\(2011\)885](#))
- › Roadmap to European Strategy and Action plan towards a sustainable bio-based economy by 2020 ([EC, 2010](#))
- › Bioeconomy Strategy (Innovating for Sustainable Growth) (EC, 2012)

In addition, the Circular Economy Strategy Roadmap ([EC, 2015b](#)) and the final EU action plan on circular economy ([COM\(2015\)614](#)), adopted 2 December 2015, as well as a number of adopted legislative initiatives on waste (see [COM\(2015\)595](#) on waste; [COM\(2015\)596](#) on packaging, and [COM\(2015\)594](#) on the landfill of waste, see also the implementation plan ([SWD\(2015\)260](#)) holds important information on how a circular economy could be envisioned and realised, although not addressing wood use and energy production explicitly. Recently, the work on a future Energy Union ([COM\(2015\)80](#)), is more clear on the potential conflict between production of wood for energy and other resources, when stipulating "the EU will also need to take into account the impact of bioenergy on the environment, land-use and food production."

The EU and the United Nations Framework Convention on Climate Change (UNFCCC)

Objective 4: Obtain GHG benefits from use of Biomass for Energy

The European Union and all EU Member States are Parties to the United Nations Framework Convention on Climate Change (UNFCCC) ([UN, 1992](#)), the objective of which is to achieve stabilisation of greenhouse gas (GHG) concentration in the atmosphere at a level, which prevents dangerous anthropogenic interference with the climate system, later agreed to be 2 °C. The ratification of the UNFCCC was approved by [94/69/EC Council Decision](#) of 15 December 1993.

Forest and biomass in the UNFCCC

In article 4(1), litra C of the Convention economic sectors that needs to undertake mitigative action are listed:

"...technologies, practices, and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors."

and in litra D, where sustainable management of sinks (i.e. Forests) is highlighted:

"Promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems"

Forests within the framework of the UNFCCC

While not taking up a more prominent role in the Convention text itself, forests has come to play an increasingly important role in the international climate negotiations (COP) over the years, in particular with the work done on REDD+ and LULUCF (AFOLU) in the context of the later Kyoto Protocol ([UN, 1998](#)). This increased focus reflect the fact that forest globally store a significant share of global carbon, and can act as both a carbon sink and a source.

Parties of the Kyoto Protocol, including the EU and all its MS, have committed themselves to QELROs. It should be noted that biomass contributes significantly to the achievement of the quantitative targets as it makes up the bulk of renewable energy (in the EU and globally). Emissions from biomass combustion are counted as zero in the energy sector. This, however, assumes that the sourcing and use of the biomass does not lead to GHG emissions, or that any such emissions are properly accounted elsewhere, such as in the LULUCF sector of the country where the biomass originates from.

Forests and biomass in EU climate acquis

The 2020 emission reduction agreed internationally (under the Kyoto Protocol) has been transposed into EU law, in the form of the EU2020 targets enshrined in the Climate and Energy Package for 2020 ([EC, 2015a](#)). The EU as a regional economic integration organization in the sense of article 4(4) of the Kyoto Protocol has thereby towards the international community and not least, the parties to the Kyoto Protocol, committed to reduce GHG emissions. The US, on the other hand,

is a party to the Convention, but has not ratified the Kyoto Protocol and has no comparable commitment to reduce emissions.

It is noteworthy, that removals by, or emissions from management of forests or changes in forest land (afforestation, deforestation and reforestation) is not included in the accounting towards the EU2020 emission reduction target. Towards the UN reduction commitment for 2020 however, both changes in forest land and management of existing forest is included under specific accounting rules.

As climate change has been mainstreamed into many parts of the EU acquis, a great number of policies and strategies support reducing emissions, directly or indirectly. For a subset of these policies, bioenergy, wood or forest play a role in the context of mitigating climate change, including notably the EU-ETS, the Effort Sharing Decision and the Renewable Energy Directive.

While the purpose of the ETS is to ensure emission reductions and push for clean technologies, some of the other policies mentioned include climate change alongside other important objectives. The Renewable Energy Directive (RED, [Directive 2009/28/EC](#)), however, is very clear in its support for climate change mitigation, as recital 1 states that:

"The control of European energy consumption and the increased use of energy from renewable sources, together with energy savings and increased energy efficiency, constitute important parts of the package of measures needed to reduce greenhouse gas emissions and comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change, and with further Community and international greenhouse gas emission reduction commitments beyond 2012".

Bioenergy and Indirect Land Use Change (ILUC)

The use of bioenergy resource comes with the risk of emissions from land use and land-use change. The methodology in the RED for calculating the GHG impact of biofuels on a life-cycle basis includes emissions from direct land-use change, but not overall land use impacts. However, it was recognised that when the biofuels originate from already existing cropland and their production does not involve direct land-use change, displacing food/feed production from the land without reducing food supply necessitates the production to be compensated elsewhere, possibly involving land-use change, and that this impact can be considerable. To determine the impact of such indirect land-use change (ILUC) of the increased consumption of biofuels, the Commission have conducted an ILUC impact assessment ([SWD\(2012\)343](#)), incl. summary ([SWD\(2012\)344](#)), and a report on ILUC ([COM\(2010\)811](#)), which was the basis of a Directive (2015/1513) that amended the RED with the aim to reduce ILUC emissions. The key provisions of the ILUC Directive included a limitation on the share of "biofuels produced from cereal and other starch-rich crops, sugars and oil crops and from crops grown as main crops primarily for energy purposes on agricultural land" to no more than 7% of the final consumption of energy in transport, and the identification of feedstocks and fuels that were found preferable for the production of bioenergy, and therefore made eligible for double-counting towards the targets.

Such assessments have not yet been completed for solid biomass used for electricity and heat. However, the Commission's Communication on the 2030

policy framework for climate and energy (COM(2014)15) provides some initial context to the treatment of biomass in the future (post-2030):

"... An improved biomass policy will also be necessary to maximise the resource efficient use of biomass in order to deliver robust and verifiable greenhouse gas savings and to allow for fair competition between the various uses of biomass resources in the construction sector, paper and pulp industries and biochemical and energy production. This should also encompass the sustainable use of land, the sustainable management of forests in line with the EU's forest strategy and address indirect land use effects as with biofuels."

In this light, it is clear that any action or policy by the EU and its Member States that leads to increasing emissions of GHG from production and use of forest biomass, potentially would conflict with the international objective of reducing global emissions. Even more so, the EU's own policies and strategies include several references to the need to address climate change using forests and forest products. Therefore, if increased demand from the EU for wood pellets from South East US lead to increased emission of GHG from US forestland or use of wood products, this practice would go against the objective of reducing global emissions.

8.3 Step 2: EU Policy Risks

Risks defined as any effect compromising the achievement of the policy objectives

The identified effects in the US (section 6.1) may have implications on the environment. If the environmental implications in the US resulting from increased EU reliance of imported biomass for energy compromise the achievement of any or all of the identified EU policy objectives (section 8.2), the EU faces a policy risk. In order to evaluate whether an effect has environmental implications, a number of indicators for environmental implications have been defined for each risk. These indicators are specified in Appendix G, and allow for a more concrete assessment of the link between the effect and the environmental implication.

Magnitude and likelihood of policy risks

In order to assess the policy risk, i.e. the risk that the policy objective cannot be met, the magnitude and likelihood of each combination of effect and environmental implication is assessed. This assessment is based on the evidence found in chapter 6 and the *ex post* and *ex ante* assessment in chapter 7. As a result of this assessment, the most likely risk(s) with significant impacts are carried forward.

Applied rating criteria

Score for magnitude and likelihood

The effects are tested for relevance for any of the indicators listed in Appendix G. If one or more environmental implications are observed in the Southeast US, or a possible cause and effect can be established based on existing literature, the magnitude and probability of the link between a given effect and a particular indicator for environmental implication is analysed. Each combination is assigned a score for magnitude, Small (Yellow), Medium (Orange) and Large (Red). Magnitude rating is given taking into consideration both duration in time, geographical extent and severity of impact on e.g. a particular ecosystem. Likewise, each combination is given a score for likelihood, Low (L), Medium (M) and High (H). Criteria for assigning high, medium and low scores are seen below.

Table 8-2. Criteria for assigning scores. Not relevant (NR) is used when no causality is evident. No evidence (NE) is used when the mapping done in previous chapters of this report did not yield any evidence on the specific effect-implication combination. All scores are based on expert judgment. The outcome of this analysis is seen in Table 8-3, in the subsequent section.

| | High | Medium | Low |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Magnitude | Specific to each indicator, but depends on share of US land, biodiversity, biomass, wood use, etc. that is expected to be affected. | | No, low or unclear expected effect. |
| Likelihood | Clear signal (agreement between scientists) AND At least two independent research projects or models conclude that the implication is expected as a result of the effect | Unclear signal (disagreement) and at least two independent research or modelling result OR Clear signal and one research project or model conclude that the implication is expected as a result of the effect | No modelling or research supporting the implication as a result of the effect (assumed effect) |

8.3.1 Risk 1: Loss of habitats and biodiversity

This risk concerns the policy objective related to biodiversity as enshrined in the CBD and the EU Biodiversity Strategy. Several of the effects found in the analysis of the southeast US, may have implications for biodiversity, including habitats.

Effect 1: Forest type conversion from natural forests to plantations:

Forest type conversion poses risks to biodiversity, as natural forests generally hold a greater array of habitats than plantations. Land-use change is the main driver of habitat loss in the region. While forest product markets can help keep land forested, a benefit for habitats, markets can also facilitate forest conversion to other land uses (e.g. land clearing for development) or contribute to the conversion of natural forests to plantations, something that has contributed to habitat loss and species decline.

Private property rights in the US are such that landowners can harvest timber in accordance with applicable laws and freely sell and/or convert forestland to other land uses such as urban development and agriculture. Natural forests can also be converted to plantations provided that rules for protecting threatened and endangered species are followed.

Forest conversion and plantation growth

Historically, plantations expanded on marginal agricultural land, but also at the expense of naturally regenerated pine, some of which has been identified as habitats of significant conservation concern, though forested wetlands were also converted to pine plantations, as were upland hardwoods (McGrath, 2004; Wear & Greis, 2013).

From 1950 to 2000, the area of pine plantations grew from 728,434 hectares (1.8 million acres) to 13 million hectares (32 million acres), to around 16 million hectares (40 million acres) in 2013 (Fox et al., 2007; Wear & Greis, 2013). Plantation expansion can happen quickly if market conditions are ripe. In just 20 years, between 1990 and 2010, the amount of pine plantations doubled from 8 million hectares to 16 million hectares (20 million acres to 40 million acres). In

Georgia and Alabama for instance the increase in plantation acres from 1972 to 2013 was 130% and 300% respectively (Hartsell, 2013; Brandeis, 2015).

Land use change and forest type conversion, while legal, often degrades and/or permanently destroys ecologically valuable areas. In their study of biodiversity risks in the South associated with an expanding bio-economy, Evans et al. (2013a) identify forest conversion as among the largest risks. Fragmentation of the forest cover, as is the risk for NIPF forests especially, reduces the value of the forests as habitat, and a decline in ecosystem services.

Site- and landscape-level impacts to wildlife habitat and biodiversity

The prospects for a sizable expansion of pine plantations at the expense of natural forests pose potential site- and landscape-level impacts to wildlife habitat and biodiversity (Evans et al., 2013a). As the goal of intensive management is to maximize timber output, at the site-level, pine plantations typically provide less biodiversity value than semi-natural or natural forests, such as comparably less legacy features (Lohr et al., 2002; Riffell et al., 2011; Evans et al., 2013a; McGrath, 2004).

Projections from the US federal government suggests that in the next 45 years a 2.8-11 million hectare increase in plantations could lead to the loss of naturally regenerated pine and hardwood forests (Wear & Greis, 2013). Ultimately, the significance of the association of new bioenergy demand to plantation expansion depends on whether this increased demand induces new investment in converting natural forests to planted pine. Modelling of future energy demand scenarios by Alavalapati et al. (2013), Abt et al. (2014), and Galik & Abt (2015) suggests that while plantation area is expected to expand in the future in part in response to energy demand, the magnitude of demand strongly influences where new plantations occur (marginal agricultural land or natural forest).

Relatively low demand scenarios (Galik & Abt, 2015) suggest that additional demand could lead to marginal increases of all forest types over time compared to a declining baseline, with plantations almost exclusively expanding on marginal agricultural land in the early years. Conversely, relatively high energy demand scenarios resulting from strong domestic and foreign demand could contribute to increases in plantations at the expense of natural forest (Wear & Greis, 2013; Alavalapati et al., 2013; Abt et al., 2014). For instance, Abt et al. (2014) project that by 2025, the area of natural forest in the Coastal Plain could decrease by approximately 2 million hectares with plantation acreage expanding by about 2.4 million hectares.

| Risk 1: Loss of habitats and biodiversity – Conversion of forests | | |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Loss of habitat | Red: Conversion of natural forests to plantations result in biodiversity decline. Projections for urban development point to loss in forest habitat as well, although timber markets help combat this trend. High: Several studies pointing to a decline in biodiversity as a result of loss of primary forest | M |

| | | |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Nutrient loss and leakage | Inconclusive evidence. | NE |
| Freshwater quality decline | Yellow: BMPs are effective in protecting freshwater quality and biodiversity when properly implemented, and are generally implemented quite frequently. Medium: General agreement | M |

Effect 2: Intensification of management and harvesting

Industrial plantation management often involves intensive site preparation, specifically piling of logging residues, disking, bedding, herbicide use, and planting of selectively bred trees (Fox et al., 2007; Dwivedi et al., 2011). Such activities are followed by mid-rotation thinning and fertilization, resulting in pine plantations routinely producing three times as much biomass as their natural analogues (North Carolina Forestry Service, 2012; Fox et al., 2007).

Harvesting of a greater percentage of stand components than in stem-only harvesting, by reducing the amount of organic material that provide important habitat functions, can also affect soil biophysical conditions with consequences to plant communities. Greater removal of wood biomass for bioenergy raises concerns about whether adequate levels of nutrients (e.g. calcium, magnesium, and potassium) can be maintained to protect site productivity (Janowiak & Webster, 2010). Many tree components that comprise a small amount of biomass, such as leaves, cambium, and root tips, contain a proportionately large quantity of nutrients when compared with tree wood (Hakkila, 2002; Powers et al., 2005). Models of forest nutrient budgets suggest that intensive whole-tree harvesting can cause long-term productivity declines (e.g., Boyle et al., 1973; Pare´ et al., 2002).

A long-term study found an average productivity reduction of 18% in loblolly pine plantations following whole tree harvesting (Scott & Dean, 2006). While this may be compensated on industrial managed lands, where chemical application and site preparation technique can likely overcome site nutrient loss (although it involves financial and environmental costs), in less intensively managed stands owned by NIPF owners this could translate into a loss of productivity. In Alabama and Mississippi, most NIPF owners preferred harvesting that includes biomass removal (Paula et al., 2011; Grunchy et al., 2012). This is often due to the fact that such removals help reduce costs of site preparation for establishing a pine stand.

| | | |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Risk 1: Loss of habitats and biodiversity – Intensification of management and harvesting | | |
| Indicator for environmental implication | Reasoning | Score |
| Loss of habitat | Yellow: The intensification of harvesting is less relevant for wood pellet export markets since they are not utilizing logging residuals and focus on pulpwood and mill residuals. Medium: General agreement | M |

| | | |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| Nutrient loss and leakage | <p>Orange: Greater removal of wood biomass for bioenergy raises concerns about whether adequate levels of nutrients can be maintained to protect site productivity. Intensive whole-tree harvesting can cause long-term productivity declines. In some studies productivity losses do occur but in intensive silviculture in the Southeast, these are more than offset by productivity gains.</p> <p>Low: Limited evidence</p> | L |
| Freshwater quality decline | <p>Yellow: Herbicide and fertilizer use in plantations can reduce water quality</p> <p>Low: Limited evidence.</p> | L |

Effect 3: Increased pressure on forests of high biodiversity value

Risks to most rare, threatened, or endangered species are somewhat site dependent. Yet, some forest types harbour a disproportionate share of these species and the Southeast US has numerous globally rare, threatened, and endangered plant and animal species. Many of which are endemic to the region, existing nowhere else.

Some of these important habitats exist within the procurement areas of industrial pellet mills and are largely not considered protected (see Figure 35). These can include some naturally regenerated pine forests and upland and bottomland hardwood forests (see section 3). Effect 1 (land use change and type conversion) is expected to contribute to pressure on some forests of high biodiversity, particularly naturally regenerated pine savannahs. Forested wetlands are the other forest type with high biodiversity that is at risk.

The regulatory framework governing management of forested wetlands focuses on preventing conversion of wetlands through dredge, fill, and drainage activity, and as such, the legal framework does not regulate timber harvesting activities in wetlands in the Southeast US beyond activities related to water quality and quantity. In fact, the most recent National Wetlands Inventory of the US Fish and Wildlife Service detected significant levels of harvesting of forested wetlands in the southeast US (Dahl, 2011). While legal, the harvesting of wetland forests (especially those in the +80 year age class, representing only 12% of the forested wetlands in the region), is opposed by many environmental advocacy groups in the US Southeast of the increasing carbon stock and important habitats these forests represent (NRDC, 2015a; Dogwood Alliance, 2013).

Modelling by Abt et al. (2014) found that forecasted demand for domestic and export bioenergy markets in the Southeast US could increase hardwood harvesting in the Coastal Plain (containing most of the region’s bottomland hardwood forests). A recent analysis of wood supply in the Virginia and North Carolina Coastal Plain also found that a cluster of industrial pellet plants located in this region relies heavily on hardwoods (Prisley, 2015). Finally, this is consistent with results from the *ex post* analysis presented in chapter 7 (Figure 41) which detected a reduction of live and dead bottomland hardwood trees from 2009 to 2012 within the supply areas of the industrial pellet mills on the Atlantic Coastal Plain.

| Risk 1: Loss of habitats and biodiversity – Increased pressure on forests of high biodiversity value | | |
|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Loss of habitat | Red: Some pine savannahs, upland hardwood forests and forested wetlands are ecologically valuable, and use of these species for energy present dangers to these habitats. Upland hardwoods and forested wetlands are ecologically valuable, and some are of particular value due to their age, structure, and the species they harbour. High: Evidence that loss of upland hardwood and forest wetlands takes place. | H |
| Nutrient loss and leakage | No evidence | NE |
| Freshwater quality decline | No evidence | NE |

Effect 4: Displacement of existing wood users and possible indirect effects

It is clear that a significant part of the pellet supply originates from resources that would otherwise be utilised by other users. E.g., sawmill residues are a favoured feedstock of pellet production because of their quality and price, but most of the available supply would be used by incumbent industries in the absence of pellet production. These resources have to be replaced from other sources in the same region, or they may lead to a migration of industry to other regions or a substitution of their products with comparable alternatives. However, the variety of possible displacement pathways made it prohibitive to substantively evaluate these effects in the context of this study.

| Risk 1: Loss of habitats and biodiversity – Displacement of existing wood users and indirect effects | | |
|------------------------------------------------------------------------------------------------------|---------------|-------|
| Environmental implication | Reasoning | Score |
| Loss of habitat | Not evaluated | NE |
| Nutrient loss and leakage | Not evaluated | NE |
| Freshwater quality decline | Not evaluated | NE |

Summary of risk

Forest type conversion following from the increased demand for biomass for energy can result in increased pressure on forests of high biodiversity value and loss of biodiversity and habitats in the US Southeast. The growth in plantations largely came at the expense of longleaf pine, which has been identified as a critical habitat type, though forested wetlands were also converted to pine plantations, as were upland hardwoods, both of which are ecologically valuable habitats. Pellet mills are often singled out as “the problem” concerning harvest of forested wetlands in the Southeast, though other significant markets affecting forested wetlands are also found. Nonetheless, the prospects for a sizable expansion of

pine plantations at the expense of natural forests pose potential site- and landscape-level impacts to wildlife habitat and biodiversity.

The risk of loss of habitats and biodiversity in the US Southeast is counterproductive to the fulfilling of target 6 under the EU 2020 Biodiversity Strategy, i.e. to help avert global biodiversity loss.

As such, there is a risk that the aggregate demand increase in biomass for energy acts as an indirect driver of habitat and biodiversity loss in the US Southeast. This goes against Action 17 of the Biodiversity Strategy that seeks to "Reduce indirect drivers of biodiversity loss" ([COM\(2011\)244](#)).

8.3.2 Risk 2: Deforestation and conversion of natural forests

This risk concerns the EU objectives enshrined in the EU Forestry Strategy ([1999/C56/01](#)), the Forest Action Plan ([COM\(2006\)302](#), [SEC\(2006\)748](#)), the Deforestation Communication (COM(2008)645) and other documents. Several of the effects relate directly or indirectly to these objectives, and may pose risk to the attainment of the objective.

Effect 1: Forest type conversion from natural forests to plantations

Conversion of natural forests to pine plantations has been extensive in all regions of the US Southeast. From 1950 to 2000, the area of pine plantations grew from 1.8 million acres to 32 million acres, and then to 40 million acres in 2010, with a doubling taking place from 1990 to 2010 (Fox et al., 2007; Wear & Greis, 2013). An example of the large growth can be found in Georgia and Alabama, where the increase in plantation acres from 1972 to 2013 was 130% and 300%, respectively.

The growth in plantation acreage is expected to continue. The Southern Forest Futures Project forecasts that bioenergy will be the largest source of new demand for wood biomass. This is expected to drive some of the expected expansion of pine plantations, which will come at the expense of both agricultural land and natural forests of comparatively high biodiversity value. The area of natural forest in the coastal plain is expected to decrease by about 5 million acres, while pine plantation acreage is expected to expand by 6 million acres until 2025. Over the next 45 years, a 7-27 million-acre increase in plantations is expected (Wear & Greis, 2013). From a base year of 1997 through 2060, the USDA Forest Service forecasts a loss of 4.5 – 9.3 million hectares (11 - 23 million forested acres) in the region (Wear & Greis, 2013). In line with this, although in the lower end, the USGS concludes that forest loss could amount to nearly 4 million hectares (10 million acres) by 2050.

The connection between timber markets and landowner preference for conversion to plantations is well documented. "Forest landowners have shown a strong propensity to convert naturally regenerated forests to planted pines after harvesting, especially in the Coastal Plain, an investment response that is strongly linked to the condition of forest product markets" (Wear & Greis, 2013). Especially non-industrial private forests (NIPF forests) are at risk of being converted to other

land uses (Zhang & Mehmood, 2001; Zhang et al., 2009, which results in the forests, often less than 50 acres in total, being broken up into smaller parcels. The Southern Forest Futures Project concluded that under strong timber demand, plantation area will expand at the expense of natural forests.

| Risk 2: Deforestation and conversion of natural forests – Conversion of forests | | |
|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Loss of natural forest area | Red: Bioenergy is foreseen to be the largest new source of demand driving the conversion. Plantations expected to expand at the expense of agricultural land and natural forests. Impact on hardwood forest areas uncertain. H: Several sources, mostly in agreement. | H |
| Declining levels of stock | In the short run, increasing levels of harvest inevitably leads to reduced stoking compared to the baseline. However, this can be partly compensated over time by other demand-driven factors, such as higher growth of regenerating stands (including an increase in plantation area) and market-driven reductions in the conversion of forest to other land uses. At the moment, the effects on this indicator have not been quantified.. | NE |
| Increased Hemeroby | Orange: Natural forest converted to plantations increase the degree of human influence. Medium: Several sources. | H |

Effect 2: Intensification of management and harvesting

Forest loss is a significant concern for the region (Wear & Greis, 2013). Much of the argument for supporting forest bioenergy has been the presumption that strong timber markets beget more forestland, or more specifically, that high timber prices bolster the ability of forests to compete with agriculture and urban development (Miner et al., 2014; Zhang et al., 2015; Wear & Greis, 2013). Based on historical observations of landowner behaviour, regional land-use projections conclude that strong timber demand begets expansions in tree plantings and plantation area, which is expected to grow at the expense of natural forests. Conversely, Galik & Abt (2015) project that under increasing bioenergy market demand, the area of all forest types (including naturally regenerated pine and wetland forests) would be higher than in the baseline (i.e. the expected losses would be reduced).

| Risk 2: Deforestation and conversion of natural forests – Intensification of management and harvesting | | |
|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Loss of forest area | Orange: Sourcing from hardwood would lead to pressure to convert to plantations | L |

| | | |
|---------------------------|-------------------------------------------------------------------------------------------------------------------|----|
| | Low: Limited evidence | |
| Declining levels of stock | Not estimated. | NE |
| Hemeroby | Orange: Intensification and increased harvesting increase the degree of human influence. Low: Limited evidence | L |

Effect 3: Increased pressure on forests of high biodiversity value

Natural forests can also be converted to plantations provided rules for protecting threatened and endangered species are followed. In their study of biodiversity risks in the Southeast associated with an expanding bioeconomy, Evans et al. (2013) identify forest conversion as among the largest risks.

| Risk 2: Deforestation and conversion of natural forests – Increased pressure on forests of high biodiversity value | | |
|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Loss of forest area | Orange: Sourcing from hardwood would lead to pressure to convert to plantations Medium: | M |
| Declining levels of stock | Not estimated. | NE |
| Hemeroby | No evidence. | NE |

Effect 4: Displacement of existing wood users and possible indirect effects

Questions persist about the role biomass harvests play in forest conversion. On the one hand, some argue that it can help reduce conversion pressure. On the other hand, some argue that it facilitates conversion (i.e. clearing of forests or conversion of agricultural land). While strong timber markets encourage investment in forestland, it can be argued that this can occur at the expense of natural forests, as landowners may decide to invest in a pine plantation instead of a naturally regenerated forest type. Moreover, it remains unclear which, if any, effective controls can be used by pellet facilities to ensure that volumes derived from land clearing for development remain out of bioenergy supply chains.

| Risk 2: Deforestation and conversion of natural forests – Displacement of existing wood users and indirect effects | | |
|--------------------------------------------------------------------------------------------------------------------|-----------|-------|
| Indicator for environmental implication | Reasoning | Score |
| | | |

| | | |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Loss of forest area | Orange: Questions persist about the role biomass harvests play in forest conversion. On the one hand, it can help reduce conversion pressure. On the other hand, it facilitates conversion. In addition, displacement of other products can lead to (indirect) loss of forests. Low: Role of bioenergy in forest conversion disputed (little agreement) | L |
| Declining levels of stock | Not estimated. | NE |
| Hemeroby | No evidence. | NE |

Summary of risk

Conversion of natural forests to pine plantations has been extensive in all regions of the US Southeast, with a doubling of plantation area from 1990 to 2010. The growth in plantation acreage is expected to continue with bioenergy presenting the largest source of new demand for wood biomass. Some of the expected expansion of pine plantations will come at the expense of natural forests, which is expected to decrease by about 5 million acres, while total plantation area is expected to expand by 6 million acres.

The conversion of natural forests to plantations is thus largely driven by increased demand for bioenergy that follows from the EU policy decision, which thus acts as an indirect driver of deforestation. This is counterproductive to the fulfilment of several EU policy objectives.

Firstly, it is counterproductive to the overall EU objective of a reduction in deforestation of 50% by 2020 (COM(2008)645). Even more tangible, the Parties to the Aichi Targets of the UNCBD, including the EU, agreed to "at least halve and where feasible bring close to zero the rate of loss of natural habitats including forests;" an objective which the conversion of forest area as a result of bioenergy demand runs counter to.

Secondly, several EU roadmaps and strategies implies that the EU should take the impact of policies on the environment into account. Specifically, the Forest Strategy (COM/2013/659) emphasize that the impact of policies on forests should be taken into account, while the 7th EAP calls for an assessment of the environmental impact, in a global context, of EU consumption of non-food commodities. This includes developing policy proposals to address the findings of such assessments, if appropriate, and considering an EU action plan on deforestation to step up EU action and identify relevant policy options to address the drivers of deforestation and forest degradation at global scale.

Finally, high agricultural prices occurring in parallel to demand increases for wood biomass could aggravate the impacts by less agricultural land being converted to pine and an uptick in the amount of natural forest converted to pine.

8.3.3 Risk 3: Reduced Resource Efficiency and Circularity

This risk concerns the objectives of the EU to increase resource efficiency (as seen in the resource efficiency strategy ([COM\(2011\)21](#))) and transition towards a circular economy ([COM\(2015\)614 final](#)). The effects relate directly or indirectly to the competition for materials as well as the potential for cascading use of biomass resources.

Effect 1: Forest type conversion from natural forests to plantations

Some additional demand can still be absorbed by the region, but at some point, economic displacement and leakage could occur. Estimates vary on when and at what level of demand this happens.

Over the next few years, demand for pulpwood and other non-sawtimber Roundwood categories attributed to industrial wood pellet plants is expected to increase to just below that of the region's OSB panel market. Potential negative environmental effects associated with market leakage and displacement could include making attainment of GHG reduction targets more difficult.

Future demand for forest biomass feedstocks for US-based energy could increase. While this sector would be capable of using logging residues, pulpwood would be needed too (Abt et al., 2010; Galik et al., 2009). Under demand scenarios modelled by Abt et al. (2014), market leakage would be expected.

The traditional forest products industry is concerned about rising prices because it affects profit margins and their ability to compete globally. Given the size and global importance of the Southeast timber market (17 – 28% of global Roundwood; 1999 - 2012) (Prestemon et al., 2015) suggest structural changes within southeast fibre markets could have rippling effects globally (Hewitt, 2011). The scale and nature of such impacts are very difficult to predict.

Wood fibre markets are the dominant force shaping southern forests. A study by Hansen et al. (2013) concluded that the disturbance rate of forests in the US South was four times that of South American rainforests during the study period with more than 31% South-eastern forest cover showing disturbance and/or regrown during 2000 – 2013. The effects of increasing demand for pulpwood for pellets and other uses are difficult to predict, but based on past periods of increased pulpwood demand, it is expected that increased investment in forests (e.g. more planting) will accompany growing demands, and price induced planting of pine is forecasted over the medium to longer terms. In other words, while harvesting of pine across the south will increase in response to prices, net growth also increases as landowners invest in new pine plantations.

As such, plantations are forecasted to expand. Abt et al. (2014) used the SRTS model to model the effects of the level of demand specified by Forisk, and found that recent trends in increasing prices for pellet feedstocks would likely continue over the next decade. However, the price responsiveness of owners of upland and bottomland hardwood forests is more difficult to model, meaning that the area change expected here becomes uncertain.

Adding to this, agricultural commodity prices have surged upwards in recent years. Following a historic 75% price increase in agricultural commodities over just 2 years (2005 – 2007), in part driven by a major new Federal biofuels policy, agriculture expanded significantly (Hausman et al., 2012). This resulted in about 198,000 acres of forest being replaced by cropland between 2008 and 2012 (Lark et al., 2015). It is largely unknown how planted pine in restructuring fibre markets will fair against high agricultural commodity prices. One potential result could be less agricultural land being converted to pine and an uptick in the amount of natural forest converted to pine

| Risk 3: Reduced Resource Efficiency and Circularity – Conversion of forests | | |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Material competition | Yellow: Opposite trends; Price induced planting of pine is forecasted. However, increasing prices can also drive conversion of forests. Medium: Disagreement over trends | M |
| Decreasing cascade use and Circular Economy issues | Not estimated. | NE |

Effect 2: Intensification of management and harvesting

In general, large quantities of logging residuals are not utilized as a main feedstock for wood pellets, as some operators prefer clean feedstocks with low ash content and low risk of soil and other contaminants (a risk that occur with utilizing logging residues). In areas where pellet demand occurs alongside of local wood energy demand (for industrial process heat and electric power), whole-tree in-woods chipping is a fairly common occurrence and is related to multiple markets for whole-tree chips (mulch, energy, etc.) and to land clearing.

| Risk 3: Reduced Resource Efficiency and Circularity – Intensification of management and harvesting | | |
|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Material competition | Orange: Use of whole trees for bioenergy compete with other uses (local presence of facilities can increase occurrence). Low: Limited evidence | L |
| Decreasing cascade use and Circular Economy issues | Orange: Pellet mills source whole trees, though this would require higher prices, which imply risks of lower cascading use and general circular economy trends. L: Limited evidence. | L |

Effect 3: Increased pressure on forests of high biodiversity value

Aggregate increase in wood demand could result in compromised integrity of environmental conditions (e.g. water quality, biodiversity), and the additional pulpwood demand attributable to industrial pellets and domestic bioenergy is likely to result in additional pressure on high-biodiversity forests, such as longleaf pine and bottomland hardwoods. In addition, some pellet mills appear to be locating in areas to largely source from hardwood forests and some wood pellet mills in the southeast US are currently sourcing from areas identified by conservation organizations as having high biodiversity value.

Higher logging residual utilization rates could pose trade-offs to stand-level biodiversity and other values. Research into the use of logging residuals for the European market has found that the current configuration of the pellet export industry makes higher utilization rates of logging residuals challenging for technical and logistical reasons (Hoefnagels et al., 2014b).

| Risk 3: Reduced Resource Efficiency and Circularity – Increased pressure on forests of high biodiversity value | | |
|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Material competition | Orange: Additional pulpwood demand attributable to industrial pellets and domestic bioenergy is likely to result in additional pressure on high-biodiversity forests. Pellet mills appear to be locating in areas currently sourcing from areas identified by conservation organizations as having high biodiversity value. L: Limited evidence. | L |
| Decreasing cascade use and Circular Economy issues | Yellow: Utilization of logging residuals beneficial for cascading use, but potential biodiversity impacts. Low: Limited evidence. | L |

Effect 4: Displacement of existing wood users and possible indirect effects

It was found that feedstock costs are perhaps not a limiting factor for pellet mills, as e.g. subsidies allow energy producers from the EU to procure at higher cost. Hence, if non-sawtimber Roundwood prices continue to rise, and pellet mill paying capacity truly is approaching levels suggested, then the export pellet market could begin sourcing feedstock used by other wood-based sectors. As the aggregate demand for feedstocks increases it is possible that smaller sized sawtimber could be used as feedstock for pulp, pellets, and/or composites (Abt et al., 2014). However, demand would have to significantly raise prices to cause a detectable increase in the utilization of smaller sized sawtimber as traditional sawtimber markets remain the dominant driver of timber utilization decisions.

Given the size and global importance of the southeast US timber market (17-28% of global Roundwood between 1999 and 2012) (Prestemon et al., 2015) structural

changes within southeast fibre markets could have rippling effects globally (Hewitt, 2011). The scale and nature of such impacts are very difficult to predict. Nonetheless, gauging when, where, and to what degree market leakage occurs relates directly to concerns about the net GHG emission effects of a restructuring bio-economy.

Pulpwood prices increased by as much as 22% between 2009 and 2012 and further prices increases are expected for the next few years as more demand appears and pine pulpwood inventories remain relatively low. At the same time, growing demand from wood pellets has added competition.

Some of the increased competition for feedstocks in the short-term could be alleviated by pellet mills sourcing the segment of harvests less sought after by other industries, like hardwood. That being said, little empirical evidence that significant market restructuring is happening due to marginal demand increases. However, it should be noted that timber markets can and do adjust slowly to rapid increases in demand. This implies that broader market effects (e.g. a planting response) that could now be in motion, may not be wholly evident for a while, and the increased harvest on existing forest (in the region or elsewhere) will dominate in the short run.

| Risk 3: Reduced Resource Efficiency and Circularity – Displacement of existing wood users and indirect effects | | |
|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Material competition | Red: Higher prices of pulp, wood and other products. Higher wood demand could result in structural changes within southeast fibre markets. This could have rippling effects globally; broader market effects may be in motion. Medium: Some evidence on changes, but limited evidence that significant market restructuring is taking place | M |
| Decreasing cascade use and Circular Economy issues | Mill residues being diverted from incumbent industries to pellet (energy use) reduces the material use of baseline harvests. However, increased harvest for roundwood for pellet demand makes more residue available for other uses. Effects have not been estimated. | NE |

Summary of risk

US Pulpwood prices increased by as much as 22% between 2009 and 2012 and further prices increases are expected for the next few years as more demand appears and pine pulpwood inventories remain relatively low. Aggregate increase in demand for wood pellets has added competition with displacement of existing wood use and other possible indirect effects resulting from this. The net-effects of additional wood demand for energy are still uncertain, but could result in structural changes in regional fibre markets.

Furthermore, large quantities of logging residuals are not utilized as a main feedstock for wood pellets, as some operators prefer clean feedstocks with low risk of soil and other contaminants (a risk that occur with utilizing logging residues) which displace other uses of the wood. In areas where pellet demand occurs alongside of local wood energy demand, whole-tree in-woods chipping is a fairly common occurrence and is related to multiple markets for whole-tree chips (mulch, energy, etc.).

Under the Flagship initiative on Resource Efficiency ([COM\(2011\)21](#)), a number of strategies for increasing resource efficiency are put forward. The increased competition for biomass resources can potentially decrease resource efficiency by allocating to bioenergy ahead of other resource uses, thus running the risk of diminishing cascade use. The recent Circular Economy Action Plan spells out that "a cascading use of renewable resources, with several reuse and recycling cycles, should be encouraged where appropriate" (COM(2015) 614/2). Therefore, such development would run counter to the EU initiatives and strategies as well as the flagship.

The Energy Union ([COM\(2015\)80](#)) explicitly highlight a potential conflict between production of wood for energy and other resources, when stipulating that "the EU will also need to take into account the impact of bioenergy on the environment, land-use and food production." This broadens the perspective, as bioenergy resources not only compete with other material uses of the wood, but also with other uses of productive land, e.g. food production.

8.3.4 Risk 4: Non-attainment of the desired GHG benefits

Risk 4 concerns the risk associated with production of biomass, namely that production of biomass to meet EU demand will fail to contribute to a net reduction of overall GHG emissions, a stated aim of the policy. However, the overall GHG impact of biomass use depends on a number of factors both on the production and use side, and its interpretation is subject to debate. This means that analysis of overall effects and risks pertaining to the use of biomass is outside the scope of this study.

That said, the study acknowledges that per unit energy output, biomass fired electric power, thermal, and combined heat and power produce more GHG emissions than fossil fuel fired energy and that this in itself can be perceived as a risk. The actual difference between biomass and fossil fuels depend on the efficiency and size of the respective power plants, with larger and newer plants generally being more effective. These issues and the related policy discussions in the US are covered in Section 5.3

Since initial combustion emissions of bioenergy per-unit energy are higher than those of fossil fuel alternatives, GHG benefits only result following the harvest and combustion of biomass if increased sequestration occurs post-harvest at a level sufficient to compensate for the excess emissions from bioenergy to the extent that this sequestration is additional to (higher than) what would happen in the scenario that fossil fuel use were to continue and the harvesting/collection of biomass were

not to occur (EEA, 2011; Searchinger et al., 2009; Searchinger, 2010; Walker et al., 2010; US EPA, 2012). This means that the reference case, i.e. the amount of carbon, which would have been absorbed by the forest in the absence of bioenergy, and the way in which this is accounted for, will affect the total GHG effects of increased demand for bioenergy, which again is depending on the modelling and assumptions, not least as concerns counterfactuals (see e.g. Matthews et al., 2015, Report 1). It is important to notice that the methodology for accounting for this can change the benefits accounted for (by virtue of the baseline) which can again differ from the actual carbon change in the forest (i.e. what the atmosphere sees).

The above means that it is not within scope of this study to fully assess the GHG impact of the use of biomass in the EU relative to any counterfactuals, including the energy mix and the energy sources substituted. How the overall carbon impacts and benefits of biomass will be (ac)counted in the EU is still subject to discussion, but recent studies indicate that the following factors play a dominant role:

- › in the case of primary/secondary sources, carbon stock changes in the area of biomass harvest compared to the counterfactual (carbon stock change in the absence of biomass harvest)
- › in the case of tertiary biomass, the counterfactual use of the of biomass
- › the extent to which biomass for energy can be co-produced with other products, allowing efficiency gains
- › displacement effects (of biomass use or land use)
- › efficiency of supply chain

Further discussion on carbon neutrality of wood energy in the EU can be found in Matthews et al. (2015) and it will not as be covered exhaustively in this study. This study provides a case study of one important sourcing region, and evaluates whether there are clear evidence of effects in this region and attributional to EU import and subsidies, that could lead to the risk of not attaining the desired GHG benefits from use of biomass for energy purposes in the EU.

Effect 1: Forest type conversion from natural forests

Forest loss is a significant concern for the region (Wear & Greis, 2013). Regional land-use projections conclude that strong timber demand have also resulted in tree plantings and plantation area, and notably the projections find that this is expected to grow at the expense of natural forests, meaning conversion. The Southern Forest Futures Project suggests that bioenergy is expected to be the single largest source of new demand for forest products and finds that this will drive expansion of pine plantations, however involving conversion of both agricultural land and natural forests. This suggests that increasing demand for wood products can lead to establishing plantations on forested as well as agricultural land (Wear & Greis, 2013), though the division between the two land use types will again depend on

agricultural prices. In addition, it is largely unknown how planted pine in restructuring fibre markets will fair against high agricultural commodity prices. If high pulpwood prices persist as forecasted, one potential result could be less agricultural land being converted to pine and an uptick in the amount of natural forest being harvested and subsequently converted to planted pine. Ultimately, the significance of the association of new bioenergy demand to plantation expansion on natural forestland depends on whether this increased demand induces new investment in converting natural forests to planted pine.

That said, the signal from increased demand as concerns forest type conversion is only recently taking off, and would not necessarily appear clear in the mentioned period. The ex-post modelling, indicates a small loss of carbon stock (associated with fewer dead trees) through to 2040, but no clear signal for carbon pools as such. In aggregate, this means that the causality is rather clear, and some studies confirm the cause-and-effect, but given the short time period of data, no signal is yet clear. Thus, a low likelihood is given to the effects, mostly due to the unclear signal, not because the causality is unclear. Magnitude is potentially high due to the size of the carbon stock in the forests at risk of being converted.

| Risk 4: Loss of carbon stock – Conversion of forests | | |
|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Loss of carbon stock | Orange: Carbon stock losses to increased harvest may be compensated by faster growth of pine where hardwoods are replaced. Net-growth still exceeding timber removals, but carbon levels in forest still low. Long-range projections suggest a declining forest carbon stock in the US. Low: Limited evidence | L |
| Soil carbon loss from drainage of wetlands | Not estimated | NE |
| GHG emissions from production and use of wood products | Orange: intensive site preparation and fertilizer use increase the GHG intensity of plantations. Low: Limited evidence | L |

Effect 2: Intensification of management and harvesting

Over the last 60 years, the South has enjoyed steadily increasing timber inventories due in large part to strong timber markets. This has led to increased investment in forest growth, especially the establishment of extensive pine plantations. Timber volumes in multiple forest types continue to swell, with net-growth exceeding timber removals at the regional and state levels. However, while the extent of forests in the eastern US has largely returned, only about a third of the forest carbon lost through deforestation has been regained (Ryan et al., 2010).

| Risk 4: Loss of carbon stock – Intensification of management and harvesting | | |
|-----------------------------------------------------------------------------|-----------|-------|
| Indicator for environmental | Reasoning | Score |

| | | |
|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| implication | | |
| Loss of Carbon stock | Orange: Increasing timber harvest causes direct and immediate losses of carbon stocks compared to the baseline. It can be compensated over time by higher increment in the regenerating forest and market-induced effects, such as lower conversion of forest to other land uses and expansion of pine plantations on agricultural land. Low: Limited evidence | L |
| Soil carbon loss from drainage of wetlands | Not estimated. | NE |
| GHG emissions from production and use of wood products | Yellow: Intensive site preparation and fertilizer use increase the GHG intensity of plantations. This can increase the GHG impact of the final good. Low: Limited evidence | L |

Effect 3: Increased pressure on forests of high biodiversity value

Pellet mills operating in areas with bottomland hardwood forests will be highly dependent on both upland and bottomland hardwoods as their primary feedstock (Prisley, 2015; Abt et al., 2014). This raises concerns, because hardwoods have represented a growing carbon inventory, especially bottomland hardwoods which can be relatively slow growing as compared to other systems in the region and capable of storing significant carbon. Yet while increased harvesting is occurring, Abt et al. (2014) project that removals will not outpace growth at the regional level. A recent analysis questioning the utilization of bottomland hardwoods as feedstock for pellets found that such a forest energy system does not yield GHG reduction benefits (Buchholz & Gunn, 2015; Stephenson & MacKay, 2014).

Modelling projections suggest that pine plantation area expansion could lead to more carbon being stored on the landscape in the long run, but result at the expense of natural forests with comparatively greater biodiversity value.

| Risk 4: Loss of carbon stock – Increased pressure on forests of high biodiversity value | | |
|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Loss of carbon stock | Red: Utilization of bottomland hardwoods as feedstock for pellets does not yield GHG reductions. Low: Three studies on this topic have been identified. | M |
| Soil carbon loss from drainage of wetlands | Red: Harvest of bottomland hardwoods leads to drainage of these areas and subsequent release of soil carbon. Low: Limited evidence of this practice taking place, as under the law only temporary drainage is allowed. The risk is thus more theoretical than likely. | L |
| GHG emissions from production and use of wood products | NE | NE |

Effect 4: Displacement of existing wood users and possible indirect effects

As shown by the analysis in chapter 7, current level of displacement is low, and where relevant confined to a few individual mills. However, due to EU subsidies some EU power producers would be able to pay a higher price for feedstock than the current market price, thus theoretically driving competition for resources, such as larger diameter roundwood. This could possibly drive increased harvest activity, which would affect the carbon stock of the region. Furthermore, the use of roundwood has unfavourable net-emissions effects in the short to medium term (see e.g. Agostini et al. (2013)), but it remains uncertain to what extent this will take place. If this materialized on a larger scale, it could present risks of not meeting the emission reduction intent of EU policies (Matthews et al., 2015). Still, over the longer-term higher prices could result in a planting response and more forest carbon being added to the landscape.

| Risk 4: Loss of carbon stock – Displacement of existing wood users and indirect effects | | |
|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Indicator for environmental implication | Reasoning | Score |
| Loss of carbon stock | No clear evidence for this happening (NE), but the potential effect could be significant (Red). | NE |
| Soil carbon loss from drainage of wetlands | No evidence | NE |
| GHG emissions from production and use of wood products | Orange: Unfavourable net-emissions effects if larger diameter Roundwood is utilized for bioenergy. Low: Limited evidence of this practice taking place at present, but could increase over time, as some evidence suggest that pellet mills could compete with pulp and paper mills for feedstock. | L |

Summary of risk

Forests of the Southeast US play a large role in mitigating GHG emissions in the contiguous US. The strong timber market has led to increased investment in forest growth, especially the establishment of extensive pine plantations. Timber volumes in multiple forest types continue to swell, with net-growth exceeding timber removals at the regional and state levels. However, during the last three decades, the net rate of carbon storage in the South, while still positive, has slowed down due to increased harvesting and urbanization. As bioenergy presents the largest source of new demand for wood biomass, loss of cumulative carbon stock as a result of forest conversion and increased aggregate demand must be considered a risk.

Following from risk 2 on conversion of forest areas discussed above, it follows that forest conversion not only has impacts on land use and biodiversity/habitats, but also carries a risk of increased emissions of CO₂ and loss of carbon stock.

Further to this, loss of carbon stock resulting from the increased pressure on forests of high biodiversity value is a risk. This raises concerns, because hardwoods have represented a growing carbon inventory. Pellet mills operating in

areas with hardwood forests will be highly dependent on both upland and bottomland hardwoods as their primary feedstock.

Following from risk 3 on Reduced Resource Efficiency and Circularity discussed above, which showed that increased competition for biomass materials can displace existing uses, there is a risk that increased demand for bioenergy can lead to increased emissions of GHG from production and use of wood products.

An increase in emissions of GHGs as a result of increased EU demand for biomass for energy would run counter to several EU Directives, roadmaps and initiatives. An increase in emissions of GHGs would furthermore be counterproductive to meeting the EU commitments under the UNFCCC, including the work on and commitments towards REDD+ and LULUCF (AFOLU) in the context of the Kyoto Protocol.

Table 8-3. Scoring of effects against environmental indicators

| NE = No evidence found NR = Not relevant, meaning no direct causality established | Indicators for Environmental Implications | | | | | | | | | | |
|--------------------------------------------------------------------------------------|-------------------------------------------|---------------------------|----------------------------|---------------------------------------|---------------------------|--------------------------------------|----------------------------------------------------------|----------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------|
| | 1. Protect and Improve biodiversity | | | 2. Halt deforestation and degradation | | | 3. Resource Efficiency and optimal use of wood-resources | | 4. Attainment of GHG benefits from use of wood pellets for energy | | |
| Effect of increased EU demand | Loss of habitat | Nutrient loss and leakage | Freshwater quality decline | Loss of forest area | Declining levels of stock | Hemeroby (degree of human influence) | Material competition | Decreasing cascade use and Circular Economy issues | Loss of Carbon stock | Soil Carbon loss from drainage of wetlands | GHG emissions (tCO ₂) from production and use of wood products |
| 1. Forest type conversion from natural forests to plantations | M | NE | M | H | NE | H | M | NE | L | NE | L |
| 2. Intensification of management and harvesting | M | L | L | L | NE | L | L | L | L | NE | L |
| 3. Increased pressure on forests of high biodiversity value | H | NE | NE | M | NE | NE | L | L | M | L | NE |
| 4. Displacement of existing wood users and possible indirect effects | NR | NR | NR | L | NE | NE | M | NE | NE | NE | L |

NE and NR

Not relevant (NR) is used when no causality is evident, i.e. the effect has no direct environmental implication on the indicator in question. No evidence (NE) is used when the mapping done in previous chapters of this report did not yield any concrete evidence on the specific effect-indicator combination, i.e. a direct causal link might theoretically exist, but no direct environmental implication was found. All scores are based on expert judgment considering the reviewed literature.

Combinations given NE or NR are not taken forward, even if, in the case of the former, a causal relation could be established between the effect and the environmental implication. There is one exceptional case: The loss of carbon stock potentially related to displacement of wood users (effect 4) was found to be theoretically significant (red), but the sparse evidence so far does not allow for an evaluation of the likelihood. Therefore this combination is given NE on red, *and* is taken forward.

Risks 1 and 2 comes through with the strongest evidence

In conclusion, risks 1 and 2 comes through with the strongest evidence, magnitude and signal. Risks 3 and 4 comes through somewhat weaker, dominated by low likelihood and at most medium magnitude. For the former two, it appears that increased EU reliance on biomass for energy imported from southeast US can have environmental implications that compromise EUs objectives to both halt (global) loss of biodiversity and to halt (global) deforestation and degradation. Both medium and high magnitude and medium and high likelihood is found for one or more combinations of risks and environmental implications. Based on the assessment, dedicated EU action to address these risks could be justified.

Clear signal on risk 3

For risk 3, the main concern is that increased material competition, spurred by demand for bioenergy, can lead to increased pressure on forests of high biodiversity value, either directly for biomass or indirectly through displacement of existing wood users and other indirect effects. Along the same lines, increased demand for wood resources can lead to decreased cascade use; both of these trends complicate the fulfilment of EUs circular economy-related policies. The ex-ante modelling in chapter 7 did confirm some expected increase in prices on US wood markets and thus potential increase in material competition.

Relevant risk, but unclear signal

For risk 4, the main concern would be decrease in carbon stock (compared to the counterfactual) in southeast US or via leakage at national or even global scale. The ex-post modelling in chapter 7, showed no clear signal of a decline in C-pools to date, and the ex-ante modelling did not include c-stock as such. Nonetheless, the causality and research is rather strong in indicating that this might develop into a considerable risk. Against this backdrop, it is difficult to assess the intervention tools to address GHG risks in detail, as there is no clear baseline for the further development in US carbon stocks and taking into account all relevant changes would go beyond the scope of this study. Thus, EU action could not be assessed for effectiveness. That said the perceived magnitude and relevance justifies the further assessment of the risk in this study, albeit without an assessment of a baseline to measure effectiveness of tools against.

8.3.5 Characterisation of the relevant policy risks

Characterisation of policy risks is necessary to allow for a transparent development of appropriate EU action. EU action shall also respect the principles of subsidiarity, proportionality and rely on sufficient mandate. As EU action such as schemes or new legislation is not the subject of this analysis, each risk will be characterized by a number of attributes that concern subsidiarity and proportionality only. Issues on mandate is relevant in the context of preparing a proposal, and thus should be considered at that point in time.

Risks will also be characterised by attributes that concern type of action to mitigate the risk. The policy risks are characterized by the below listed attributes:

- › **Specific** (to feedstock, source ecosystem, Member State(s), etc.) or general risk. This will allow for assessing whether the risk is of a nature that justifies action in light of the principle of subsidiarity.
- › **Temporary or permanent** risks (both in terms of driver and already planned safeguards/countering legislation), to allow assessing whether action is needed immediately, at a later stage or not at all. This will also allow to assess whether the risk is of a nature that justifies legislative action or soft law or communicative efforts (e.g. white paper/guidelines)
- › **Complexity** of the risk, i.e. to what degree it will affect other actors than EU and other objectives than EU policy objectives. This is used to assess the risk in light of proportionality, i.e. the scale of appropriate EU action.
- › **Direct or indirect risk**, i.e. is the link between EU demand and the risk direct or indirect
- › **Underlying drivers**. Referring to chapters 6 and 7, this outlines the drivers of this particular risk, in order to identify appropriate EU action targeting the driver.

Framework for characterisation

Each of the relevant policy risks are characterised using the below questionnaire. Questions and answers have been scoped to indicate the nature of the risks, and thus the nature of the problem, and not intended as a full analysis qualifying as an impact assessment.

- › **Specific risk:** Is the policy risk specific to:
 - › A limited type of feedstock (e.g. wood pellets from primary wood) or a clearly identified supply chain and end user?
 - › More than 10% of all feedstock imported into the EU from North America?
 - › No more than a few Member States.
- › **Temporary or Permanent risk:** Is it foreseen in cited models/literature that the policy risk will diminish for other reasons than EU or federal US action before 2020?

- › If yes, EU Action could be to issue a Communication or Staff Working Document to send a market signal.
- › If no, legal action should be considered
- › **Degree of complexity:** Does the risk, if unmitigated, have negative impact (incl. costs) on:
 - › EU citizens
 - › EU businesses outside of the energy sector
 - › US energy sector
 - › US businesses outside of the energy sector
 - › Third countries, other than EU and US
 - › Direct or Indirect:
- › **Underlying drivers:** What drivers have been identified and how, if at all, do each of them:
 - › Supply side drivers (Impact supply of wood pellets to EU operators)
 - › Demand side drivers (Impact demand for wood pellets by EU operators)

The assessments in the tables on the following pages is based on causality and evidence.

8.3.6 Risk 1: Loss of habitats and biodiversity

Table 8-4. Overview of characteristics of risk 1

| Attribute and question | | Answer to question and explanatory text | Characteristics of intervention |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Specific | Is the risk limited to a particular type of feedstock (e.g. wood pellets from primary wood) or a clearly identified supply chain and end user? | Mainly feedstock from plantations recently converted from longleaf pine stands, upland hardwoods and forested wetlands. Indications are that particular pellet mills might play a central role. | Targeted at certain source ecosystem or converted ecosystems. Possibly including a pellet mill component. |
| | More than 10% of all wood pellets imported into the EU from North America? | Yes. The risk would be limited to non-certified pellets and pellets from plantations recently converted from natural forest. Of current imports, more than 20% is still not certified. | Target Non-certified pellets |
| | A specific MS or less than five member states. | Currently the majority of wood pellets from the US is imported by UK, NL, BE, DK and IT, however this could increase. To the extent that other MS would increase their imports more would be subject to the risk. While the specific subject of this investigation is US imports, similar environmental implications could possibly be observed on other exporting countries, including internal EU exporters. Thus, the risk could concern more than the current 5 MS in a future scenario. | Target major importers |
| Temporary | Is it foreseen in cited models/literature that the policy risk will diminish for other reasons than EU or federal US action before 2020? | No, rather it is expected the pressure could increase. | Temporary legislation or guidance not sufficient |
| Degree of complexity | Does the risk, if <i>unmitigated</i> , have negative impact (incl. costs) on: | | |
| | EU citizens | No, not directly | No immediate issues on proportionality, if action is sufficiently targeted. |
| | EU businesses outside of the energy sector | No, not directly | |
| | US energy sector | No, not directly | |
| | US Businesses outside of the energy sector | No, not directly | |
| | Third countries | No, not directly | |
| Underlying drivers | EU drivers | EU Incentives for bioenergy (EU-ETS, support schemes, certificates etc.) drive up aggregate demand that drive landowner behaviour towards conversion. However, general developments in wood markets (increased wood demand) indicates that non-EU drivers could be driving the loss of habitat. | |
| | US drivers | US bioenergy demand. | - |

8.3.7 Risk 2: Deforestation and conversion of natural forests

Table 8-5. Overview of characteristic of risk 2

| Attribute and question | | Answer to question and explanatory text | Characteristics of intervention |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Specific | Is the risk limited to a particular type of feedstock (e.g. wood pellets from primary wood) or a clearly identified supply chain and end user? | Yes, to some extent similar as for risk 1. The risk of degradation mainly concerns feedstock from plantations recently converted from longleaf pine stands, upland hardwoods and forested wetlands. | Geographically targeted |
| | More than 10% of all wood pellets imported into the EU from North America? | Yes. The risk would be limited to non-certified pellets and pellets from plantations recently converted from natural forest. Of current imports, more than 20% is still not certified. | Target non-certified pellets |
| | A specific MS or less than five member states. | Currently the majority of wood pellets from the US is imported by UK, NL, BE, DK and IT, however this could increase. To the extent that other MS would increase their imports, more would be subject to the risk. While the specific subject of this investigation is US imports, similar environmental implications could possibly be observed on other exporting countries, including internal EU exporters. Thus, the risk could concern more than the current 5 MS in a future scenario. | In the short term target major importers, however more MS could become significant importers of third country wood pellets |
| Temporary | Is it foreseen in cited models/literature that the policy risk will diminish for other reasons than EU or federal US action before 2020? | No, rather it is expected the pressure could increase. | Temporary legislation or guidance not sufficient |
| Degree of complexity | Does the risk, if <i>unmitigated</i> , have negative impact (incl. costs) on: | | |
| | EU citizens | No, not directly | No immediate issues on proportionality, if action is sufficiently targeted. |
| | EU businesses outside of the energy sector | No, not directly | |
| | US energy sector | No, not directly | |
| | US Businesses outside of the energy sector | No, not directly | |
| | Third countries | No, not directly | |
| Underlying drivers | EU drivers | EU Incentives for bioenergy (EU-ETS, support schemes, certificates etc.) drive up aggregate demand that drive landowner behaviour towards conversion. However, general developments in wood markets (increased wood demand) indicates that non-EU drivers could be driving the loss of habitat. | |

| | | |
|--|------------|---------------------|
| | US drivers | Increased EU demand |
|--|------------|---------------------|

8.3.8 Risk 3: Reduced Resource Efficiency and Circularity

Table 8-6. Overview of characteristic of risk 3

| Attribute and question | | Answer to question and explanatory text | Characteristics of intervention |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Specific | Is the risk limited to a particular type of feedstock (e.g. wood pellets from primary wood) or a clearly identified supply chain and end user? | No, the exact issues on material competition may depend on the feedstock in question and its alternative use, however increased material competition could be relevant for all feedstock | Targeting demand |
| | More than 10% of all wood pellets imported into the EU from North America? | Yes, in principle all wood pellets. Some feedstock may however face tougher competition and thus prices increases, potentially driving out some uses with low buying capacity. | Targeting demand |
| | A specific MS or less than five member states. | Material competition resulting from increased use of wood for pellet production in the US would be most intense in the US. However, as markets are global and other EU non-energy users could source wood from US in principle all EU wood based industries could face material competition. | Targeting all sectors and MS to minimize distortion |
| Temporary | Is it foreseen in cited models/literature that the policy risk will diminish for other reasons than EU or federal US action before 2020? | No indications that the risk is temporary, but the material competition is not intense for the moment. It is, however, expected to increase in particular after 2020. | Legislative action in the long term could be necessary, but for the time being evidence is still argue and a Communication might be an option if issue where to be addressed by sending a signal to the market. |
| Degree of complexity | Does the risk, if unmitigated, have negative impact (incl. costs) on: | | It is a rather complex risk, with many second order/indirect effects through disruption in local, regional and global markets. Any EU action would have to take due care that more distortion is not induced into the market, and that excessive burdens are not but on various actors. |
| | EU citizens | If prices of wood as such goes up, certain wood-based materials could go up. | |
| | EU businesses outside of the energy sector | Same as above. Access to wood as input to production of various goods could be increasingly difficult. | |
| | US energy sector | If EU sources a substantial amount of the produced wood pellets, somewhat less will inevitably be available for US energy producers, unless production and harvest is increased. This again, could drive the other risks. | |
| | US Businesses outside of the energy sector | Same as above. Access to wood as input to production of various goods could be increasingly difficult. | |

| | | | |
|--------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Third countries | Given global markets for most wood, material competition could be extended to third countries. This study has not investigated this in particular and thus no conclusions could be made on this. | |
| Underlying drivers | EU drivers | EU Incentives for bioenergy (EU-ETS, support schemes, certificates etc.) drive up aggregate demand for wood for wood pellets, which are expected to put upward pressure on price for at least some types of wood. | Targeted EU demand |
| | US drivers | Increase in wood demand for e.g. construction of homes or energy production in the US add to the aggregate material competition. Likewise, if land prices go up in certain regions, forestland could be converted leading to decrease in supply, further intensifying material competition. | Effectiveness of EU action should be seen in light of other increases in demand. If EU Action target sustainability of production, other sources of demand not applying such sustainability requirements could source non-sustainable biomass (leakage issues) |

8.3.9 Risk 4: Non-attainment of the desired GHG benefits

Table 8-7. Overview of characteristic of risk 4

| Attribute and question | | Answer to question and explanatory text | Characteristics of intervention |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Specific | Is the risk limited to a particular type of feedstock (e.g. wood pellets from primary wood) or a clearly identified supply chain and end user? | Not necessarily. Our findings suggest, based on e.g. Buchholz and Gunn (2015) that wood pellets made from bottomland hardwoods did not yield GHG benefits, but this does not mean that other types of wood or sourcing areas cannot deliver benefits. More research is needed, and in any case, it would be very case specific. | Should target primary biomass, but more evidence is needed. |
| | More than 10% of all wood pellets imported into the EU from North America? | | An approach targeted pellets from feedstock with no net GHG benefits |
| | A specific MS or less than five member states. | | Targeted major importers |
| Temporary | Is it foreseen in cited models/literature that the policy risk will diminish for other reasons than EU or federal US action before 2020? | No, not temporary. Nevertheless, the signal is not clear for the time being. | Legislative action needed based on firmed up evidence. |
| Degree of complexity | Does the risk, if unmitigated, have negative impact (incl. costs) on: | | |
| | EU citizens | In the sense that net loss of carbon stock in the US leads to increased atmospheric levels of GHGs, climate change is not mitigated and all EU | |

| | | | |
|--------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | citizens (as well as citizens of third countries) will eventually feel the impact. | |
| | EU businesses outside of the energy sector | Not directly. However, given that global emissions should be reduced, other industries could face a stronger pressure to limit their emissions. | |
| | US energy sector | Given a US commitment to reduce emissions of GHGs (see US INDC), eventual net loss of carbon could increase the pressure on achieving reductions elsewhere in the energy sector or in other sectors. | |
| | US Businesses outside of the energy sector | | |
| | Third countries | Not directly. However, given that global emissions should be reduced, third countries could face a stronger pressure to limit their emissions. | |
| Underlying drivers | EU drivers | EU Incentives for bioenergy (EU-ETS, support schemes, certificates etc.) drive up aggregate demand that drives landowner behaviour towards a number of decisions and actions that could potentially reduce carbon stock in forests, most notable conversion of carbon rich natural forests to plantations. | Is it is inherently tricky to allocate carbon loss at regional scale to specific wood uses; the effectiveness of any EU action would be difficult to estimate and not least verify. For individual supply chains, more solid estimates could be produced. |
| | US drivers | US demand for wood, for energy or other purposes adds to the aggregate demand for wood, which again could drive land owner behaviour towards decisions and actions that reduce carbon stock. | |

8.3.10 Summary and conclusion

Summary of characteristics of risks that could guide EU action

In summary, a couple of observations from the assessment holds important aspect that should be applied in the process of developing policy action in next section.

- › Some **similarities between risk 1 and 2**, leading to the observation that EU action should be targeted at both risks, to reduce complexity, legislative pressure and administrative burdens. Behind this similarity lies the fact that processes leading to loss of habitat and leading to deforestation and degradation are similar and in some instances the same.
- › Risk 3 is rather complex, as it plays out in the interlink between several markets and wood uses. It is inherently difficult to regulate such a risk, in particular as EU only controls one driver out of several. In addressing this risk, specific consideration should be given to proportionality and not least potential competitive disadvantages (e.g. costs and administrative burden) and market distortion.

- › It appears from this assessment, and the findings of chapter 7, that the EU incentives promoting wood based bioenergy is the main driver of increased EU wood demand from US, and thus one of the main drivers of the policy risks. For all risks however, the driver works in concert with US drivers (endogenous drivers), and the effectiveness of any EU action will thus be difficult to estimate. More work would be needed on these issues.
- › None of the risks is found to be of transient nature; however, the material competition is currently not intense, but projected. This leads to the observation that action to address risks 1 and 2 is rather urgent and should be of legal form, whereas risk 3 could be addressed in a post 2020 context. Risk 4 is not temporary (in short and medium term at least) but current magnitude is difficult to establish even if the causality would suggest that decrease in US carbon stock could be an effect of increased demand from EU. This in turn means that legal action should be subject to further scrutiny.

Conclusion on relevant risks

In conclusion, taking into consideration both the magnitude and likelihood assessment and the characterisation of policy risks, a number of important findings has been found to guide the work on policy action.

- › Risk 1 and 2 are backed with rather strong evidence showing a strong signal. Both risks concern the same drivers and have been found hold similar characteristics. In the following, EU action will be developed to address both risks.
- › Risk 3 do not appear urgent, rather it is projected to intensify in particular after 2020. It is of complex nature, and although sharing some similarities with risks 1 and 2, it calls for dedicated action. Risk 3 will be taken forward and action to address this risk will be developed.
- › Risk 4 has not been quantified in detail, but the causality behind an expected decrease in carbon stock (compared to baseline) in the southeast US because of increased EU demand for wood pellets can be assumed, at least in the short run, to the extent that the pellets originate from increased logging. Any EU action should be pre-emptive, and specific to the risk, e.g. addressing specific wood types. Most importantly, further assessment of impacts in order to establish a baseline to assess effectiveness against, should be prioritized.

8.4 Step 3: EU policy action

Backdrop for considering policy action

It is not foreseen that a new comprehensive dedicated scheme or policy should be developed to address risk specific to imports of wood pellets from the US¹¹³ or any other particular jurisdiction. Any approach taken cannot discriminate against imports and will have to apply to all import sources equally. This section therefore does not consider a legislative initiative or full-fledged policy options. Rather, it is

¹¹³ See Terms of reference for this study, p.16.

aimed at identifying and evaluating operational intervention tools that could be incorporated into existing or planned legislation and would apply to all.

The choice of format should be taken in view of the nature of the problem to be addressed, including its degree of transience, subsidiarity and proportionality. In section 8.3, the risks were analysed for these and other characteristics, which can serve to specify what format of action should be taken. In addition, any policy action will have to take into consideration the generic system constraints, the appropriate policy setting as well as the choice of intervention logic. This framework is shown in Figure 50 below.

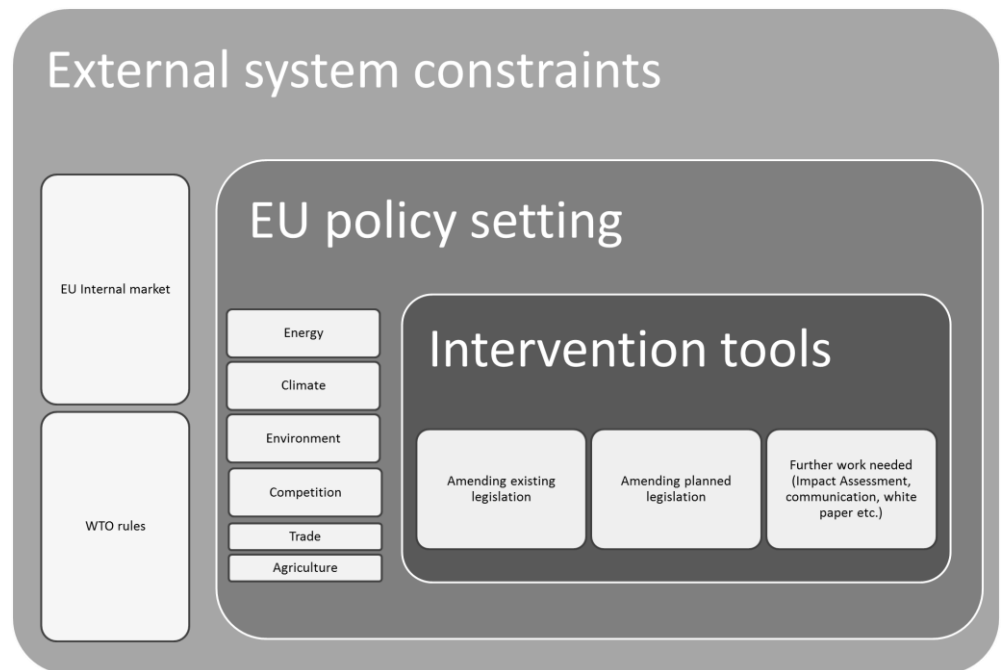


Figure 50. Framework for development of options

The two outer spheres are elaborated in the following two sections. The design of appropriate intervention tools has been dedicated the seven sections thereafter following.

8.4.1 External policy constraints

Two constraints have been found to frame the identification of possible policy action for alleviating environmental implications of EUs increased reliance of biomass for energy form the Southeast US, although none of them as such concerns environmental issues or bioenergy.

Concerns have been raised that incompatibilities between Member States' individual actions (different types of sustainability criteria, support schemes for higher efficiency of bioenergy production or eligibility exclusion from national

financial incentives) may become a barrier for international trade as well as intra-EU trade¹¹⁴.

EU and internal market

Biomass report:
Align as much as
possible existing and
planned
sustainability
schemes

As for the EU internal market dimension, the 2010 Biomass report¹¹⁵ recommended Member States to align as much as possible existing and planned sustainability schemes, in order to prevent the risk of trade barriers stemming from the development of national sustainability regulations and to address potential sustainability issues.

The 2014 State of Play biomass report¹¹⁶ stated that the individual sustainability requirements of Member States with significant trade in biomass - both international and intra EU- were not considered to diverge significantly, and no apparent trade barriers were identified. European wide initiatives such as the Sustainable Biomass Partnership (SBP) are contributing to the continued development and refinement of voluntary standards and processes. Further, the notification obligation under the Technical Standards Directive (TSD)¹¹⁷ may further ensure that draft Member State schemes applying to biomass may not constitute internal market barriers, means of arbitrary discrimination or a disguised restriction on trade¹¹⁸.

WTO law and GATT

Article XX in the
General Agreement
on Tariffs and Trade
(GATT)

Policy measures taken to achieve certain goals, e.g. in the context of biomass for energy, considerations of environmental protection or GHG mitigation, may affect trade in certain products, e.g. biomass from the US Southeast. In order to comply with WTO rules such measures should be consistent with certain principles, such as non-discrimination, necessity in relation to the policy objective sought, and non-arbitrary nature of the measures.

Exceptions to the trade rules of WTO, e.g. non-discrimination, are described in Article XX in the General Agreement on Tariffs and Trade (GATT), and are especially important concerning trade and environmental protection. Article XX becomes relevant when a policy measure is found to be inconsistent with the GATT rules.

¹¹⁴ State of play on the sustainability of solid and gaseous biomass used for electricity, heating and cooling in the EU, SWD(2014)259.

¹¹⁵ Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling, COM(2010)11.

¹¹⁶ SWD(2014)259

¹¹⁷ Directive 98/34/EC

¹¹⁸ SWD(2014)259

The principle of non-discrimination specifies that a member of WTO shall not discriminate¹¹⁹:

- › between 'like' products from different trading partners (giving them equally "most favoured-nation" or MFN status, GATT Article I); and
- › between its own and like foreign products (giving them "national treatment", GATT Article III).

'Like' products

The principle of non-discrimination raises two key questions: Are products at issue "like" products? If yes, is the foreign product treated less favourably?

In WTO case law, four criteria have been used in determining whether products are 'like' (WTO, 2015b):

- › the physical properties of the products;
- › the extent to which the products are capable of serving the same or similar end-uses;
- › the extent to which consumers perceive and treat the products as alternative means of performing particular functions in order to satisfy a particular want or demand; and
- › The international classification of the products for tariff purposes.

Production and process methods under the WTO

Concerning applicable environmental policy measures, the question then remains whether products can be treated differently because of their production and process methods (PPMs), even "if the physical characteristics of the final product remain identical. This question relates to the two basic types of PPMs: product-related production and process methods, PR-PPMs, and non-product related PPMs: NPR-PPMs." (WTO, 2015b) Under WTO, such differences do not in and of themselves render these products 'unlike,

Should the EU (or other governments) want to distinguish between biomass for energy derived from sustainable sources and biomass for energy where the production method is unknown, determining the degree of likeness can be challenging, as none of the four criteria can immediately be used to distinguish between the two types of biomass for energy. Further work on Biofuel policies and WTO law, see e.g. De Gorter et al. (2014).

119 MFN is also a priority in the General Agreement on Trade in Services (GATS) (Article 2) and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) (Article 4). National treatment is also mentioned in Article 17 of GATS and Article 3 of TRIPS (WTO, 2015a).

In summary, the introduction of further EU measures for dealing with possible policy risks identified above would need to take into account the EU’s international commitments on trade policy, in particular the principle of non-discrimination.

8.4.2 EU Policy areas

There is no existing EU legislation that covers the full range of potential environmental implications associated with increased EU reliance of wood pellets or chips from Southeast US. However, the *acquis communautaire* includes a number of policy areas that regulate or could potentially regulate demand and/or use of biomass for energy purposes.

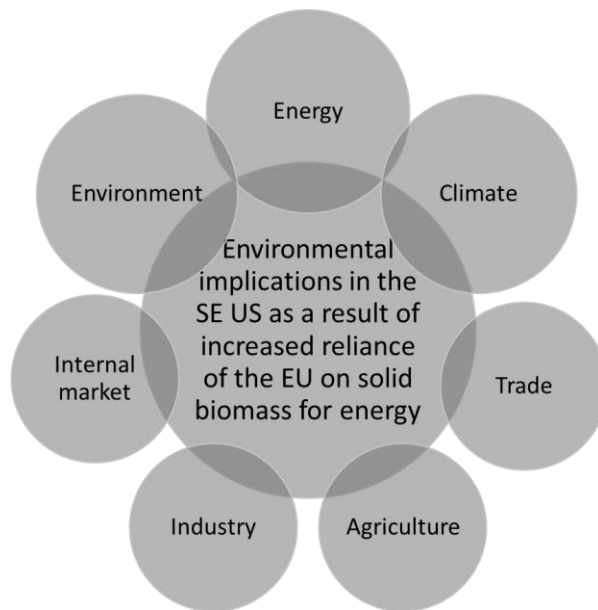


Figure 51. Commission policy areas with relevance for the topic of this study. The transition to a low carbon society based requires greater uptake of renewable energy sources, including bioenergy, which is driven by policy in the Energy acquis, most prominently the EU2020 targets and the RE-directive. The transition support the decarbonisation of EU, and shall lead to reduced carbon footprint, which is a key objective of EU climate action. Bioenergy, and in this case solid forest biomass, is produced by ecosystems, the protection of which falls under the Environment acquis. These three policy areas has clear and pertinent interests in the way the EU address the policy risks identified as a result of increased EU reliance on solid biomass from SE US (larger circles in figure).

A number of other policies have a less clear or indirect bearing on biomass use, in the sense that use of biomass for energy purposes in the EU is not clearly identified in the recital or article one of the legislation or in the introduction, in case of an strategy or roadmap. The full list of relevant policies/legislation is shown in Table 8-8.

Table 8-8. Biomass relevance of selected policies and directives

| Policy / Directive | Biomass relevance |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The EU Emissions Trading System (EU ETS) | Emissions from biomass are excluded from the ETS. Annex IV of Directive 2003/87/EC state that calculations of emissions shall be performed using the formula: |

| | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> > Directive 2009/29/EC > Directive 2008/101/EC > Directive 2004/101/EC > Directive 2003/87/EC | <p>Activity data × Emission factor × Oxidation factor, where the "emission factor for biomass shall be zero" (L 275/44) In effect, the ETS thus acts as a support mechanism for biomass for energy purposes.</p> |
| <p>European Union Renewables Directive</p> <ul style="list-style-type: none"> > Directive 2009/28/EC (amending Directive 2001/77/EC and Directive 2003/30/EC) | <p>The sustainability criteria of the RED covers biofuels, and not solid biomass such as wood pellets (unless used for biofuels/bioliquids, which is currently marginal). RED specifies that the "requirements for a sustainability scheme for energy uses of biomass, other than bioliquids and biofuels, should be analysed by the Commission in 2009, taking into account the need for biomass resources to be managed in a sustainable manner." Sustainability of biomass resources is within the subject matter of the Directive, and could potentially be included in a revision of the regulation.</p> <p>RED stipulates that the Commission shall monitor the commodity price changes associated with the use of biomass for energy and analyse "the impact of increased demand for biomass on biomass using sectors." The material completion of biomass resources is not directly within the subject matter, but could be included. However, other more obvious venues for regulation of competition issues exist.</p> |
| <p>The European Union Timber Regulation</p> <ul style="list-style-type: none"> > European Parliament and European Council Regulation 995/2010 | <p>This regulation covers timber and timber products as classified in the Combined Nomenclature set out in Annex I to Council Regulation (EEC) No 2658/87, incl. Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms; wood in chips or particles; sawdust and wood waste and scrap, whether or not agglomerated in logs, briquettes, pellets or similar forms (category 4401). The functioning and effectiveness of this regulation will be reviewed again no later than December 2021. Sustainability of biomass resources is not direct subject matter, but could potentially be included in a revision of the regulation.</p> |
| <p>The Action Plan on Forest Law Enforcement, Governance and Trade (FLEGT)</p> <ul style="list-style-type: none"> > European Council Regulation 2173/2005 > European Commission Regulation 1024/2008, 363/2012 and 607/2912. | <p>No mention of biomass for energy. Regulation does not directly apply to solid biomass for energy, and does not provide an immediate setting for regulation of solid biomass.</p> |
| <p>The European Union Common Agricultural Policy</p> <ul style="list-style-type: none"> > European Parliament and European Council Regulation 1305/2013 and 1306/2013 | <p>Support under co-operation measure for horizontal and vertical co-operation among supply chain actors in the sustainable provision of biomass for use in energy production (1305/2013). Regulation does not directly apply to imported solid biomass for energy nor to energy producers, and does not provide an immediate venue for regulation of solid biomass.</p> |
| <p>Accounting rules for Land use, Land Use Change and Forestry</p> <ul style="list-style-type: none"> > European Parliament and European Council Decision 529/2013/EU of 21 May 2013 | <p>Not a policy in itself, rather a technical specification on how to set up and manage systems for accounting for emissions and removals from land use, including forests. Vital to the biomass accounting principles of UNFCCC, KP and EU, as zero-rating in the ETS is based on the expected accounting of forest biomass in the LULUCF sector. Decision to be reviewed in light of developments in the UNFCCC context, but decision is not a suitable setting for an intervention tool. Principles, rules and modalities could however inform an intervention tool.</p> |
| <p>The European Union Biodiversity Strategy to 2020</p> <ul style="list-style-type: none"> > European Parliament Decision | <p>"Acknowledges that it is necessary to achieve an economy based on sustainable energy sources in a cost-effective way without compromising biodiversity objectives, and that such an economy could contribute towards achieving these objectives; deems it necessary, in this context, to introduce</p> |

| | |
|------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2307/2011 of 20 April 2012 | further safeguards regarding the sources, efficiency and quantity of biomass used for energy; calls on the Commission, also in this context, to clarify as soon as possible what effect biofuels have on biodiversity, including the impact of indirect land use, and calls for the establishment of effective sustainability criteria for the production and use of all biofuels, including solid biomass" |
| The new European Union Forest Strategy > European Commission communication (COM/2013/659) | For the "strategy to be meaningful to those policies that require or might require evidence of sustainable forest management and to reach its goals, objective, ambitious and demonstrable sustainable forest management criteria that could be applied to all uses of forest biomass are needed" |
| Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP) Action Plan > European Commission communication (COM/2008/397) | No mention of biomass or wood energy resources, but the subject matter is related |
| Directive on public procurement > Directive 2014/24/EU | No mention of biomass or wood energy resources in EU directive, but the subject matter is related. Several MS have included biomass in implementing policies. |
| Guidelines on State aid for environmental protection and energy 2014-2020 > European Commission communication 2014/C200/01 of 28 June 2014 | "the need to avoid distortions on the raw material markets from biomass support" |
| Communication COM(2015) 614/2 on Closing the loop - An EU action plan for the Circular Economy | "The Commission will promote efficient use of bio-based resources through a series of measures including guidance and dissemination of best practices on the cascading use of biomass and support for innovation in the bioeconomy." |

Any of these policies holds the potential to embed or host an intervention tool addressing one or more of the risks.

The detailed assessment of feasibility of the integration of any particular intervention tool into one of these policies should be subject to further analysis.

8.4.3 Generic types of intervention tools

In summary the below specifications apply to possible EU action on risk 1 and 2 in combination, and for risk 3. For risk 4, further work is needed before specifications for appropriate tools can be defined. Such work is relevant in the context of the New Biomass Policy foreseen for 2016.

Table 8-9. Overview of criteria for action based on assessment of risks.

| Risk | Magnitude and likelihood | Driver(s) | Action specifications | Format |
|---------|--------------------------------------------------------|-----------|-------------------------------------------------------------------------|---------------------------------|
| 1 and 2 | Medium to high magnitude and medium to high likelihood | EU demand | Legislative, before 2020 Respect WTO rules Should target specific | Existing or planned legislation |

| | | | | |
|---|-------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| | | | ecosystems/forests and mostly non-certified forests | |
| 3 | Medium to high magnitude and medium to high likelihood | EU and US demand | Legislative, could be post-2020 Respect WTO rules Should be demand side Targeting all sectors and MS to minimize distortion Consider societal costs | Existing or planned legislation |
| 4 | Low to high magnitude, low likelihood mainly due to unclear signal. High causality. | EU demand | Targeted specific types of wood and/or forests with no GHG benefits Should respect WTO rules in any case | Further work needed |

To identify tools that could address the identified risks existing legislation and relevant studies have been screened. Furthermore, inputs received during and as a response to the workshop has been included in the screening (see workshop minutes and overview of comments received in appendix).

The policy areas listed in section 8.4.2 (see Table 8-8) are all potential settings for action. However, considering that risk 1 and 2 concern specific ecosystems, mostly non-certified forests/wood and are driven by EU demand, the most relevant policy setting would be legislation governing EU wood pellet demand (i.e. the RED directive) or initiatives targeting nature and biodiversity (*Environment Acquis*) outside of the EU.

Relevant studies and legislation

- > Studies
 - > EC (2013c)
 - > Chatham House (2013)
 - > SWD(2012)343
 - > Matthews et al. (2015) "BioImpact"
- > Legislation
 - > Renewable Energy Directive and associated MS implementation
 - > ILUC Directive
 - > 7th EU Environment Action Program, in particular the Biodiversity Strategy
 - > UNFCCC and Kyoto Protocol

A screening of the full list of identified, relevant tools can be found in appendix F. As the ILUC Directive ([EU/2015/1513](#)) had not been published in the official journal at the time of the assessment, the assessment has been based on the proposal in combination with secondary sources.

Screening of relevant literature and planned legislation

A first step in identifying intervention tools is therefore a screening of relevant literature to identify broad types of interventions proposed. Then, existing or planned legislation in the Environment or Bioenergy *acquis*, has been screened for possible tools. Input on intervention tools from the workshop is then used to complement or gap-fill possible generic tools identified in existing or planned legislation and literature. It should be noted, that tools identified in legislation, literature or proposed at the workshop may not be detailed enough or may not target exactly the risks found. In the subsequent sections, appropriate types of intervention tools identified first selected and then modified to fit the purpose.

Identification of types of tools in existing literature

Several studies (see list below) have investigated types of tools or measures that could address one or more of the risks identified in step 2. Several of these include tools or measures designed for implementation by EU, its member states or EU based industry.

In total, the screened studies provided more than 60 tools or measures. The following criteria have been applied when evaluating for the identified tools:

- › Given that the scope of this analysis excludes development of new policies and legislation, the tool shall build on existing or planned regulation (before 2020):
 - › Directly, i.e. modifying a tool/measure already available to the EU¹²⁰
 - › Indirectly, i.e. defining a new tool in an existing regulation;
- › Bearing in mind that environmental implications take place outside of EU jurisdiction, the tools must be appropriate for EU action, and feasible given the EU mandates;
- › To ensure simplicity and efficiency the tools should address either several risks or one risk very effectively;
- › Build on existing MS or industry initiatives targeting the same or a similar type of risk;
- › Level in the mitigation hierarchy (see Figure 52), i.e. address the driver (avoid or mitigate the bespoke effect, or restore or offset the effect)

Tools that were dependent on entirely new policies or substantial new legislation as well as tools requiring legislative action in the producer country and tools directly conflicting with WTO rules were excluded. The full list of identified tools can be found in 8.5Appendix E.

¹²⁰ For this assessment we have screened existing studies on similar topics and the relevant parts of the policy *acquis* of DG ENER, CLIMA, ENV and AGRI

Mitigation Hierarchy

- › **Avoid** the effect, i.e. reduce the driver
- › **Mitigate** the effect, i.e. do not reduce the driver but attempt to limit the implications following from effects
- › **Restore** for lost ecosystem services at the same site where the loss resulting from the effect occurred
- › **Off set**, i.e. compensate for the loss at a different location, relying on principles of comparable ecosystem value and services

All identified Intervention tools have been classified according to the *Mitigation Hierarchy*. See e.g. <http://www.csbi.org.uk/wp-content/uploads/2015/09/CSBI-Mitigation-Hierarchy-Guide-Sept-2015-1.pdf>. The hierarchy has also been applied for the development of several EU Environmental Initiatives e.g. waste policy and in particular No Net Loss of Ecosystem Services

Figure 52. Mitigation hierarchy of identified intervention tools.

Those tools considered relevant taking into account the above criteria are listed below in relation to a possible intervention tool type that could combine or integrate elements from the tools identified in the existing studies. That is, while not all tools and all elements of the tools identified are included, the proposed intervention tools draw on elements of the tools identified in the literature in the design of the intervention tool. The process of identifying tools based on the literature search has been iterative, in that the screening of legislation and that of literature has been repeated several times and the resulting intervention tool types in the below Table 8-10 is a compromise proposed by the authors.

Table 8-10. Tools identified in existing literature and the proposed Intervention Tools. ID refers to number in 8.5Appendix E.

| List of tools identified in existing literature | ID | List of Intervention Tools |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----------------------------|
| <ul style="list-style-type: none"> › #3: Sustainability criteria for solid and gaseous biomass › #9: Promote and strengthen FLEGT, and expand to other commodities › #18: Mandatory labelling of the forest footprint of (food) products › #21: Strengthen voluntary initiatives certifying sustainably produced (deforestation-free) commodities › #44: Labelling | 1 | Certification |
| <ul style="list-style-type: none"> › #2: Include "indirect land use" (ILUC) in sustainability criteria for biofuels › #18: Mandatory labelling of the forest footprint of (food) products | 2 | GHG impact formula |
| <ul style="list-style-type: none"> › #3: Sustainability criteria for solid and gaseous biomass › #9: Promote and strengthen FLEGT, and expand to other commodities | 3 | No-go areas |

| | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------------------|
| <ul style="list-style-type: none"> › #35: Public procurement policies requiring legal and sustainable products | | |
| <ul style="list-style-type: none"> › #3: Sustainability criteria for solid and gaseous biomass › #9: Promote and strengthen FLEGT, and expand to other commodities › #21: Strengthen voluntary initiatives certifying sustainably produced (deforestation-free) commodities › #35: Public procurement policies requiring legal and sustainable products › #36: Government standards or criteria › #72: Sustainable public procurement | 4 | Positive/negative list |
| <ul style="list-style-type: none"> › #19: General requirement to apply stringent public procurement principles with respect to the deforestation impact of products and services › #51: Decision-tree approach for initial screening of sources of bioenergy › #52: Co-production of forest bioenergy with additional material wood products, targeting the displacement of GHG-intensive counterfactual products, and encouraging the disposal of wood products at end of life with low impacts on GHG emissions. › #59: Prioritise the end uses of wood, by matching the technical suitability of the various categories available with end-user requirements › #60: Further work at EU, national and sub-national levels to determine the cross-substitutability of different wood categories between the various real end uses available in a given geographic area as one basis for determining priorities. | 5 | Material hierarchy requirements |
| <ul style="list-style-type: none"> › #3: Sustainability criteria for solid and gaseous biomass › #18: Mandatory labelling of the forest footprint of (food) products › #19: General requirement to apply stringent public procurement principles with respect to the deforestation impact of products and services › #24: Attach sustainability criteria to the import of commodities that are associated with deforestation › #39: 'Due diligence' requirements on industry › #46: Reporting requirements | 6 | MAES |
| <ul style="list-style-type: none"> › #10: Raise awareness of the linkages between EU consumption and deforestation › #36: Government standards or criteria › #46: Reporting requirements › #66: Generational Goal – Sweden. The objective is to achieve zero deforestation or zero impact on the environment. | 7 | NNL |
| <ul style="list-style-type: none"> › #19: General requirement to apply stringent public procurement principles with respect to the deforestation impact of products and services › #61: Market distortions, which favour one group of wood buyers over another, should be eliminated, curtailed, or better directed. | 8 | Quota |
| <ul style="list-style-type: none"> › #2: Include "indirect land use" (ILUC) in sustainability criteria for biofuels › #18: Mandatory labelling of the forest footprint of (food) products › #32: Research to obtain a monitoring tool on the impact of EU consumption | 9 | Project Based Accounting Tool |

| | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <p>on worldwide deforestation</p> <ul style="list-style-type: none"> > #39: 'Due diligence' requirements on industry > #46: Reporting requirements > #50: Commitments by proponents of significant new forest bioenergy projects in the EU to demonstrate genuine and significant GHG emissions reductions. > #58: Statistics, terminology and data on forest residues harmonised within the EU. | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|

The identified interventions have been matched with existing or planned legislation in the EU energy or environment acquis. The next section is structured following the tools listed in the rightmost column of Table 8-10 above. The following text explores how a possible intervention tool could be constructed in general terms.

Certification

The Renewable Energy Directive and national implementation

Existing certification schemes (Such as FSC, ATFS, SFI and SBP) cover forest management and habitat issues, as well as deforestation, but operators of power plants in the EU are not currently obliged to use certified wood (at least for a certain share). The first characteristic of a intervention tool on certification would be to make it mandatory for use of biomass in the EU-ETS and for bioenergy counting towards existing (or post-2020) renewable energy target, at least for energy operators above a certain size (in e.g. MW capacity).

Further to the above, a certification tool enacted at EU level developed in this report would have to be additional to or improve what is already in place. This can be assessed in many ways, but in particular, two questions are asked:

- > Does existing certification schemes target, or have the potential to target risk 1 and 2? and
- > Could increasing the share of certified forests mitigate the risks?

In chapter 4, it was presented how SFI Fibre Sourcing is presently a large component of the trade in certified wood volume from the US Southeast. However, the way in which different entities meet the fibre-sourcing standard appears to vary. In a public summary by Bureau Veritas Certification, it was found that many relied entirely on state reporting of BMP compliance, and materials developed by outside parties (state agencies, Tree Farm, and the SFI state implementation committees) for understanding whether their sources may be violating BMPs, and for providing suppliers with information on proper operations and species protections. This is not a non-conformance with the Fiber Sourcing standard.

When using FSC, FSC-CW is designed to eliminate sourcing from “districts with unspecified risks” and involves a risk assessment process. Companies are required to carry out a risk assessment for their procurement, and should the audit reveal any of five issues to be an unspecified risk. Pellet mills using the FSC standard in the US will soon be required to use the FSC national risk-assessment for the US, which identifies high conservation value areas.

At present, there are no comparisons of the current versions of FSC-SFM and SFI-SFM standards currently in use, and it is thus difficult to assess which, if any, gaps there might be, as well as identifying risks not covered by any of these (or other certification schemes) This said, there are a couple of observations on differences that should guide the work on a certification tool:

- › FSC has a greater focus on biodiversity conservation. One key difference is the level of attention FSC places on species conservation and ecological issues.
- › In addition, the size of allowable openings and clear-cuts varies between the FSC and SFI Standards, and is absent from the ATFS standard.
- › The FSC and SFI approach forest type conversion differently in both their SFM and their procurement systems, and there is no limitation on use or type conversion in the ATFS standard.
- › All systems allow for the certification of pine plantations although FSC places additional restrictions on the intensity of management
- › Late successional old-growth (LSOG), is not mentioned by the ATFS standard, and addressed differently by FSC and SFI.
- › ATFS does not have a chain of custody system, or labelling schemes for wood products, so does not deal with sourcing issues.
- › SFI has the strongest focus on logger training and education.

A more complete and comprehensive overview would be necessary before designing the intervention tool in more detail. Notwithstanding the above points, the most prominent challenge remain in that only 17% of southeastern forests are presently certified. Given the extensive amount of wood harvested from small landholdings across the South this is an especially relevant topic for the development of a tool. Based on this, any extended certification tool would have to meet two main requirements, corresponding to the two initial questions, namely

- › Ensure increasing share of certified forests in EU wood pellet demand systems, in particular among the NIPF segment , and
- › Require adoption of a system that integrates and augments gaps in different certification systems (e.g. SBP+FSC/PEFC/SFI),

It is thus proposed to develop a certification tool along the lines of a mandatory requirement for use of certified solid biomass and more importantly a *Best Available Technology* feature, comprising that recent and comprehensive certifications are given an advantage in the crediting or eligible contribution. This BAT feature would have to be based on an independent ranking of certification schemes undertaken by e.g. third party verifiers annually, not unlike the credit rating system in place in the financial sectors and for government bond markets.

The tool can primarily target risks 1 and 2, but could be foreseen to cover risk 4 at a later stage. The tool will be developed further under tools to address risk 1 and 2 below.

Certification does not directly address the drivers of risks 1 and 2, namely EU demand. Mitigating risk 1 is most comprehensively addressed through adoption of FSC and implementation of an HCV process (see section 4.1), but is also addressed by SFI, and ATFS. There are also differences in the mechanisms of risk mitigation (e.g. regional or FMU level) and level of risk (e.g. species rarity rankings).

A tight(er) certification requirement could reduce the amount of sustainable biomass available, which again could lead to scarcity and thus increased prices whereby biomass could become less economically favourable to energy producers. That said, certified biomass would have fewer environmental implications, whereby the risk is *mitigated*. An alternative scenario is that EU demand will be satisfied by certified biomass, preventing other users from sourcing certified biomass and their demand would then *leak* towards not certified forests/biomass, whereby the environmental implications remain the same and at a comparable level.

GHG impact formula

Annex V, part C of the RED holds the formula for calculating the GHG impact of a given biofuel or bio-liquid. The formula constitutes a simplified Life Cycle Analysis (LCA), as it includes factors for different stages in the production and use cycle of the fuel. The GHG impact calculated from the formula is then compared with the fossil fuel comparator, whereby the GHG benefit in percentage can be found. In practical terms, many energy producers would use an Excel-based tool, such as BioGrace II for the actual calculation. Each element in the formula can be estimated/calculated or default values can be applied as given in the annex. The RED GHG impact formula currently applies to biofuels only, however in SWD(2014)259 it is proposed to be used for solid biomass as well. The approach is widely used by Energy entities when using wood pellets, e.g. for co-firing.

The LCA approach has become widely used over the last twenty years to estimate environmental impacts, called footprints. Footprints have been calculated for chemicals, biodiversity, nutrients, air pollution. There is a [guideline](#) by the Directorate for Environment and Joint Research Center (JRC) on conducting LCAs, which sets out best practice for e.g. inclusion of biogenic emissions. The guidelines does now define a formula for LCA however makes no assumptions on carbon neutrality.

Whilst LCA approaches have been widely used for the assessment of the GHG impacts of energy (including bioenergy) in different contexts, there are significant limitations that hinder their uniform application. They include:

- › Difference between "attributional" and "consequential" LCAs. Whilst the former is better suited for the assessment of the impacts of an ongoing process by allocating the total impacts within a framework among all the products/activities produced by the framework, it says little about the marginal impact of a new product/service being introduced, which is the relevant question in the context of promoting/supporting technologies (like renewables)

to introduce change (like a reduction in GHG emissions). These impacts can be assessed through consequential LCA, but that requires the modelling of all the relevant realms with a very significant expansion of the system boundary. An example of a comprehensive LCA analysis of carbon footprints of bioenergy systems can be found in [Wentzel et. al. 2014](#).

- › System boundaries, in particular for land use impacts. LCAs were originally developed for industrial applications and their representation of land use is problematic. They often ignore land or make simplistic assumption about land use impacts. The land representation of the attributional LCA of the RED was found lacking, which led to the investigation of ILUC, which is essentially a consequential LCA. However, that had to expand the land system boundary globally.

It is a prerequisite for a solid LCA that quantitative information for each of the elements in the formula is available, or that be produced based on assumptions.

This intervention tool would encompass introducing a LCA based GHG impact formula to solid biomass, in order to calculate e.g. the footprint of a consignment of wood pellets from the SE US. Further to be considered is to modify the formula to address these particular risks more targeted, e.g. by including ILUC and IWUC factors, as well as a factor for the carbon in the wood pellet itself.

No-go areas

Article 17, paragraphs 4, 5 and 6 stipulate how "biofuel and bioliquids (...) shall not be made from raw material obtained from land..."

- › with High Biodiversity Value
- › with High Carbon Stock
- › that was peatland in 2008

These lands thus constitutes "no-go areas", and the compliance is proven and tested via the verification system set out in article 18. The definition and identification of the land categories is key to the functioning of this system. High Biodiversity Value land is further identified in the directive as *primary forest, land with protection status* and *highly biodiverse grassland*. The cut-off date is January 2008 in all cases.

Definition and identification of land is a very delicate matter that has proven difficult in several legislative settings. For example, there is no EU or global definition of forest, and in the recent EU LULUCF decision MS continue a practice from the UNFCCC, using own thresholds for definition of forestland. The wording of article 17(4) in the RED on forests does not refer to any legally or research based definition of High Biodiversity Value forest, and allows for some interpretation of "primary forest and other wooded land...". The text specifically concerns land with "*no clearly visible indication of human activity and the ecological processes are not significantly disturbed*", meaning that biodiversity of re-established, managed or hybrid forest types are not included and thus not inside a "no-go area" even if of high biodiversity nature. The point in making is that the use of no-go areas as intervention tool will rely heavily on the definitions and identification of land, and

that this is a complicated matter. Notwithstanding a designated no-go area might be an appropriate response to address a risk.

No-go areas, as they are found in the RED today (concerning feedstock for biofuels), does already target certain ecosystem types as well as ruling out biomass from deforestation. If applied to solid biomass directly, and targeting the ecosystems or forests of concern, EU demand would not decrease, and it would not address the driver by avoiding the effect of it. A no-go area tool rather mitigate the risk, by limiting the supply or direct supply towards others forests. A no-go area tool thus comes with the same potential leakage issues as explained above.

Positive/Negative list

The ILUC directive¹²¹ introduces elements of positive and negative lists in the eligibility for (different levels of) support. This tool builds on that approach, which furthermore has been included in the Dutch implementation of the RED directive. In the ILUC directive it reads:

- › "biofuels produced from cereal and other starch-rich crops, sugars and oil crops and from crops grown as main crops primarily for energy purposes on agricultural land" (essentially food-based biofuels) are eligible for support only up to 7% of the final consumption of energy in transport. The Commission also has stated that it intends not to allow the support of food-based biofuels beyond 2020 (*negative list*).
- › "Biofuels produced from feedstocks listed in Annex IX of the ILUC Directive are not subject to the above restriction and which can be double counted towards the targets, thus making them more attractive for MS to support" (*positive list*).

A positive/negative list is found in the Dutch implementation of domestic sustainability criteria for solid biomass. Following the 2010 COM recommendation, the Dutch government initiated a participatory process for establishing sustainability criteria in a Dutch context. The published scheme largely follows the 2014 DG ENER SWD ([SWD\(2014\)259](#)) and covers both agricultural and forest biomass, and considers ecological, economic and management (e.g. Chain of Custody) aspects. The positive/negative list is a requirement for the decision on GHG emission benefits, and should address the so called 'carbon debt' issue (Junginger, 2015). Items on the positive list¹²² are considered not to have any GHG implications if used for energy purposes, which essentially means they are considered 'carbon neutral'. Items on the negative list¹²³ are not considered to yield GHG benefits if combusted for energy purposes. A test criterion for Roundwood applies to final harvests from long rotation forestry, and stipulates that pellets mills

¹²¹ Final text published in the OJ not available at the time of drafting. Proposal on ILUC can be found here: https://ec.europa.eu/energy/sites/ener/files/com_2012_0595_en.pdf

¹²² Positive list: Tops and branches, Thinnings, Processing residues, Post-consumer wood; Roundwood from final harvest from production forest with short (<40yr) rotation.

¹²³ Peatland/wetland converted after 2008; Forests where long term C-stocks are not maintained; Natural forests converted to plantation after 2008; Stumps, unless harvested for other reasons, e.g. infrastructure development.

must ensure and document that a maximum of 50% of the Roundwood from the final harvest may go to pellets.

A positive/negative list inspired by the ILUC directive and the Dutch example is taken forward as a possible intervention tool.

Material hierarchy requirement for green certificates

The Belgian action plan on sustainable management of biomass 2015-2020 is based on *two main principles*: the material hierarchy and the cascading principle. The *material hierarchy* describes in which order the use of biomass should be approached: (1) prevention of waste, (2) stimulate re-use, (3) recycle as much as possible, (4) other useful processes (e.g. energy source), and lastly (5) extraction of waste. The *cascading principle* provides a second principle for the order of how to prioritize the use of biomass: (1) food, (2) fodder, (3) raw material in production, and lastly (4) energy.

Building on these two principles, a list of biomass materials that can be used as energy source¹²⁴:

- a) Products consisting of organic materials or parts from agriculture or forestry, except for wood flows which are not part of b), c), e) or f), and which are used in an installation where the urban and environmental license application was submitted after June 1, 2007;
- b) Short rotation coppice;
- c) Wood flows that are not used as industrial raw material;
- d) Manure;
- e) Organic-biological waste that is collected separately and is not eligible for recycling or processed in accordance with relevant sectoral implementation plan;
- f) Organic-biological waste sorted from residual waste and is not eligible for recycling or processed in accordance with relevant sectoral implementation plan;
- g) The organic-biological part of garbage, provided that the processing by energy recuperation achieves primary energy savings of at least 35% of the energy content of the waste treated in the installation. "

If a raw material has an industrial use, it cannot be used as an energy source. Since the WTO regulations does not allow specifying this geographically, VREG opted for a technical approach where they define which materials are not considered as raw material for industrial use:

- > Bark
- > Dust (sanding dust, filter fabric, mesh fabric, fabric cutter MDF) with particle size smaller than 0.2 mm
- > Fine prunings with a diameter smaller than 4 cm
- > Twigs from forest canopy with a diameter smaller than 4 cm
- > Stumps up to a maximum of 30 cm above ground level
- > Other wood flows which Cobelpa and Fedustria declare they do not use as industrial raw material use

If a third party shows or indicates, the used material could be used for a step earlier in the hierarchy or cascade, the biomass certificate will be halted. Which

¹²⁴ (MEDE-2008-2)

means that the VREG will no longer recognize systems when they no longer meet one of the requirements to be recognized as certification by the VREG shown in section '6.1 Recognition of a certification by the VREG'. Even though this tool can be made more specific, it is an interesting example of how to use guiding principles and regulation as a tool for optimising the use of biomass resources.

MAES and Natural Capital Accounting

Initiatives under the 7th Environment Action Programme

Under action 5 of the EU Biodiversity Strategy to 2020 (COM(2011)244), Member States are encouraged to support the restoration and maintenance of ecosystems and their services (for information on ecosystem services, see e.g. [EC, 2015d](#)). To facilitate this, the Mapping and Assessment of Ecosystem Services (MAES) ([EC, 2015c](#)) has been ongoing since 2011, including in the dedicated working group and its results has been published in a number of reports ([EC, 2014](#)). The working group and its stakeholders has proposed to use the Common International Classification of Ecosystem Services (CICES) framework for integration of economic values of ecosystems services.

A natural capital based accounting system consistent with this setup, combined with a threshold for impact on or loss of ecosystem services as result of production and harvest of biomass for energy, or a risk based ranking system, could potentially address certain biodiversity risks also outside of the Union, if applied to supply chains or operators. Experiences with NCA has been gathered by most notably by Puma in their Environmental Profit and Loss (EP&L) reporting, undertaken since 2011.

The MAES/NCA tool concerns by nature biodiversity and habitats. The ultimate effect of the tool would be to limit supply, and it thus does not address the driver in a way that ensures the effects are avoided. Rather it mitigates the risk.

NNL Biodiversity offsetting

Action 7 of the Biodiversity Strategy to 2020 concerns "no net loss of biodiversity and ecosystems" in the EU by 2020. Under the action it is foreseen that "the Commission will carry out further work with a view to proposing by 2015 an initiative to ensure there is no net loss of ecosystems and their services (e.g. through compensation or offsetting schemes)". While the policy options for such a proposal primarily concerns domestic policy instruments and union biodiversity ([Tucker et al., 2013](#)), and make use of Natura 2000 areas, the CAP and proofing of biodiversity into the *acquis communautaire* in general, the concept of biodiversity offsetting could be considered as a mitigative response to the biodiversity and forest degradation risks.

There are at least a number of different variants for implementation of NNL in a bioenergy context. If full synergy with the MAES setup where to be realized, all major energy operators (for example operating one or more power stations with capacity above 20MW) in the EU could be required to map and classify all ecosystem services in the lands providing biomass for wood pellets used at their plants, and compensate any loss related to the production and harvests of wood for bioenergy purposes. While this could be a rather heavy administrative approach, a simpler version could be to maintain the constant level of biodiversity at lands under management of the operator or its suppliers. A third approach could

include extending the obligation of MS under MAES to cover global ecosystem services supporting specific country specific land use heavy imports, e.g. bioenergy. Further considerations on a Biodiversity Offsetting tool is found in the context of the specific risks in below sections.

Specific design elements of any such tool requirement has been studied by [ICF & IEEP \(2014\)](#). Furthermore, in the UK, the principles of Environment Banking¹²⁵ (BBOP, 2009; GHK, 2012) has been explored for some years, and learnings from this system could be harvested and used as well. An important characteristic worth mentioning is that offsetting *does not mitigate the risk*, rather compensates to the extent this is possible. However, depending on the design of the tool, the cost associated with mandatory offsetting could have behavioral impact on energy producers, in that they would avoid having to compensate if in any way possible.

As its name indicates the NNL tool only concerns offsetting, whereby operators are obliged to compensate the effects of their biomass demand. It does not address the driver explicitly, but leaves room for the operator to prioritize. While this could mean less negative economic impact, the tool would come with some definitional and timing issues as no two ecosystems are fully alike and restoring one particular forest to compensate for loss elsewhere not only takes time but cannot substitute the first.

UNFCCC and Kyoto Protocol

Project based accounting tool

Under the Kyoto Protocol, parties can make use of flexible mechanisms to trade emission reductions achieved through GHG mitigation projects. A long list of project types have been approved over the years (Ranging from conversion of coal power plants to biomass and afforestation projects), and guidelines and modalities, as well as systems for Monitoring, Reporting and Verification has been developed and improved¹²⁶. The key benefit of the proposed tool is to utilize and build this material and the gained experiences.

Both *Joint Implementation* (JI) and *Clean Develop Mechanism* (CDM) projects result in credits being issued for the emission reductions achieved relative to a baseline established following procedures stipulated in the rules¹²⁷. The additionality principle is essential for the discussion on GHG benefits of bioenergy systems, in that the establishment of the counterfactual is critical for the performance of the system. In addition, indirect effects are mandatory to consider for such projects.

A Project Based accounting tool would include that supply chains specific to a source (of wood pellets used in EU by operators of a certain size) should have their GHG performance calculated following the principles of the UNFCCC and KP rules

¹²⁵ <http://www.environmentbank.com/>

¹²⁶ For example see methodology AR-ACM0003: Afforestation and reforestation of lands except wetlands --- Version 2.0 at <https://cdm.unfccc.int/methodologies/DB/C9QS5G3CS8FW04MYYXDFOQDPXWM4OE>

¹²⁷ For AR-ACM0003, the baseline is set according to <https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf>

and guidelines. The source region would be defined as the project area and the project period would be the time period over which wood pellets is sourced from this region. The calculation could be done at a regional source level, so that e.g. GHG benefits would be calculated for a certain area of bottomland hardwoods. Other regionalisations could be envisioned as well. Work is needed to synthesize and merge existing rules for the purpose of such a tool; however, this is outside of the scope of this study.

Workshop input

At the workshop, several participants, including NGOs, brought up the use of quotas as an intervention tool. For an overview of comments received at or after the workshop, see appendix H.

Quotas

Quotas or caps essentially limit the supply or use of the goods or resource in questions. Several types exist, of which import quota, production quota and cap on use are reviewed in this section.

An import quota is a direct restriction on the quantity of goods that may be imported. Import quotas can be combined with permitting, so that importers need a permit to place a particular product on the importers market. An import quota on wood pellets in the EU complying with WTO trade rules is a delicate matter, and is not taken forward for analysis.

Production quotas were until recently a quite often used intervention tool in EU agricultural policy, for example the recently expired milk quota regime for European farmers ([DG AGRI, 2015](#)). The milk quota regime was put in place to address structural overproduction of milk, a challenge different in nature compared to the risks identified for this study. Notwithstanding, quota's was considered already 15 years ago as a possible tool to regulate use of solid biomass for RE purposes ([Kyritsis, 2001](#)) and the type of tool has been used e.g. in the form of green certificates (in BE) or RE-obligation (in UK), although both places tied to a support scheme to drive up integration of biomass based RE.

An example on an existing cap is set out in the ILUC directive, and concerns food-based biofuels that are eligible for support only up to 7% of the final consumption of energy in transport.

In addition, content or material quotas could be developed. This is understood as a requirement on Energy Producers to use a certain share of a certain type of biomass as part of their total used quantity of biomass.

Whilst the EU could not put quota on production of wood pellets produced in the SE US, as a principal intervention tool, the EU could consider a quantitative restriction on the share or GJ of renewable energy produced from solid biomass. A number of design elements, vital to the efficiency of the intervention tool would have to be specified. Further elaboration of the possible tool is presented in the analysis of action options.

List of intervention tools

The ten generic intervention tools identified for further consideration is listed in Table 8-11. All tools has been classified according to the mitigation hierarchy (see Figure 52), in order to be able to match tools with drivers of risks as identified in the previous section.

Table 8-11. Overview of identified generic tools. Take note that the order of the tools will change in later chapters, as they are matched with risks.

| ID | Intervention tool | Source | Mitigation hierarchy | Existing or planned legislation | Existing EU, MS or industry initiative |
|----|---------------------------------|-------------------------------------------------|----------------------|-------------------------------------------------------|----------------------------------------|
| 1 | Certification | RED | Mitigate | Existing | Yes, EU |
| 2 | GHG impact formula | RED | Mitigate | Existing, but in in first covered in a Communication | Yes, EU |
| 3 | No-go areas | RED | Mitigate | Existing | Yes, EU |
| 4 | Positive/negative list | ILUC directive, and Dutch implementation of RED | Mitigate | Existing | Yes, NL |
| 5 | Material hierarchy requirements | Flemish Implementation of RED | Avoid | Existing | Yes, BE |
| 6 | MAES | 7th EAP | Mitigate and restore | Planned | Yes, Industry (as concerns NCA) |
| 7 | NNL | 7th EAP | Off set | Planned | Yes, UK |
| 8 | Quota | Workshop | Avoid | None, but could be incorporated into several existing | Yes, EU |
| 9 | Project Based Accounting Tool | UNFCCC | Mitigate | None | No, but based on UNFCCC mechanism |

8.4.4 Selection of tools

While some of the generic tools could address one risk, several of them could potentially address both risks, and one tool could possibly cover some GHG issues. The matching of tools and risks is depicted in Figure 53, and corresponds to the description found in section 8.4.3.

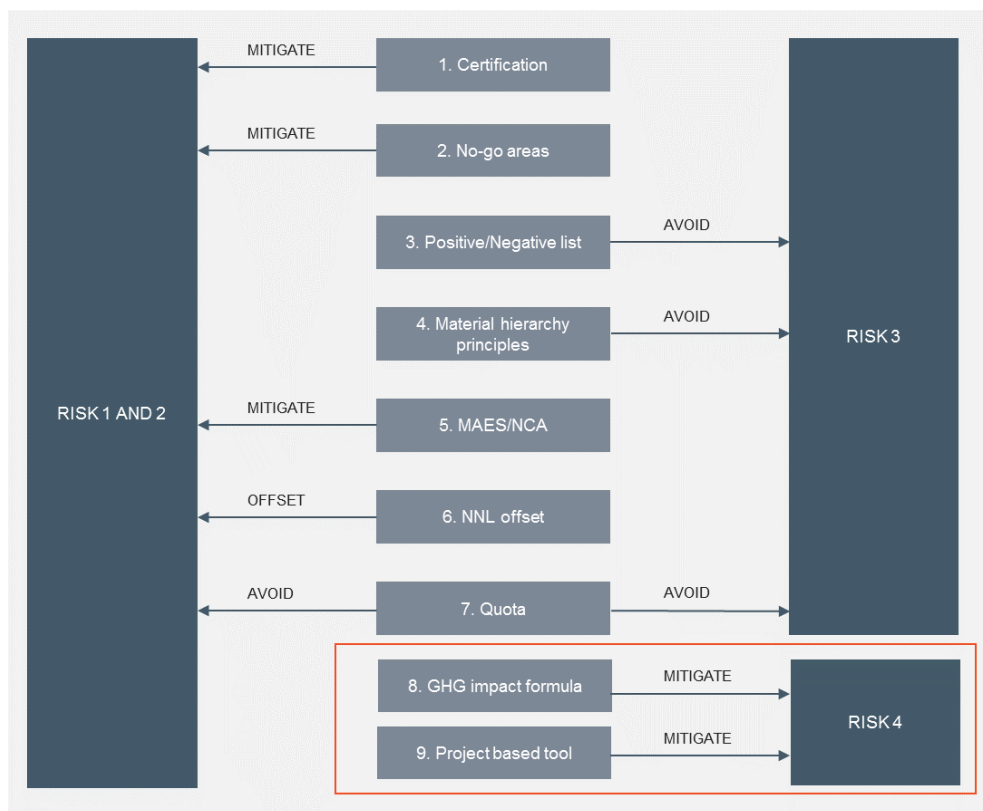


Figure 53. Linkage between tools and risks.

It is seen from Figure 53 that:

Risk 1 and 2

A certification tool (#1), no-go areas (#2), MAES/NCA (#5), NNL offset (#6) and a Quota tool (#7) could all address loss of habitat/biodiversity and loss of forests (risk 1 and 2), but in different ways addressing the drivers.

Risk 3

Tool 3, Positive negative list, if targeted at certain feedstock, and the material hierarchy principle (#4) as well as a targeted Quota tool (#7) could all address the risk of increased material competition and reduced resource efficiency.

Risk 4

Addressing risk 4 using a modification of the GHG impact formula of the Renewable Energy Directive or using the Project Based tool could be a way forward, but that further investigations are necessary. Furthermore, as a new biomass policy for the post 2020 period is underway with the Commission, the work on this could be the most suitable place to address the issue.

For each of the risks, the relevant tools will be assessed and further defined in the following sections.

Approach for assessment of tools

When assessing the intervention tools, it is in accordance with *better regulation* to assess the option for its economic, social and environmental impact in an impact assessment. This study may inform an impact assessment, but is not scoped as one and the assessment given below is therefore indicative and preliminary. The

possible options (combination of intervention tool and policy area) are thus preliminarily assessed for:

- > Effectiveness (in addressing the risk)
- > Cost (for energy producers)
- > Administrative burden (for public administration)
- > Legal obstacles
- > Undesirable side effects
- > Policy Coherence
- > Innovative

The two latter are positive criteria, in that high score indicates benefits. Undesirable side effects has been covered in the tool description in the previous section and thus not included here. The assessment is based on expert judgment. Effect is determined based on the type of tool, using the mitigation hierarchy, where tools that avoid the effect (reduce the driver) is scored not high, whereas tools that compensate/offset the effect scores low.

In order to determine the effectiveness of the policy tool in question,

$$Effectiveness\ score = Effect \times (Cost_{producer} + Cost_{Administrative})$$

When conducting a full assessment of effectiveness of tools, issues such as leakage, avoidance and ease of implementation (e.g. definitional issues and system boundaries) should be taken into consideration and ideally quantified. Having this in mind, the following grade for effect and cost was used:

Table 8-12. Ranking of effect and costs

| Score | Cost (both producer and admin) | Score | Effect (mitigation hierarchy) |
|-------|--------------------------------|-------|-------------------------------|
| 3 | Low | 3 | Avoid |
| 2 | Moderate | 2 | Mitigate |
| 1 | High | 1 | Restore/Offset |

Given the above formula, each tool can score from 2 to 18 (with 2 having the lowest effectiveness and 18 having the highest effectiveness). The following score for final assessment of effectiveness was used¹²⁸:

- > Low: Effectiveness score <7
- > Moderate: Effectiveness score 11≥7

¹²⁸ This means that four cost-effect combinations yield low effectiveness score, three cost-effect combinations yield moderate effectiveness score, and three cost effect combinations yield high effectiveness score.

- › High: Effectiveness score $18 \geq 11$

8.4.5 Ideal tools to address risks 1 and 2: Loss of habitat and biodiversity and Loss of forest and forest degradation

Best Available Certification tool

A Best Available Technology inspired approach, called Best Available Certification is foreseen. It includes a requirement that in 2020 95% of all wood pellets used in the EU (be energy operators subject to the Renewable Energy Directive criteria or any post-2020 version of it) should be made from certified wood, and that wood certified by one or two of the most comprehensive schemes is given a relative advantage over lower ranked certification schemes (or not recently recertified) wood. It means in practice that certifications using the most updated and comprehensive certification scheme would be given a relative advantage over other certifications.

In deciding what would be relevant attributes of schemes to rank by, there are at least two that could be pursued, perhaps more, utilizing existing certification schemes.

- › 1. Whether or not the scheme includes mandatory adoption of forest management certification standards at the producer level and associated COC systems (e.g. FSC and/or PEFC)
- › 3. Standards relating to risks and standards for performance (e.g. mandated requirements addressing risks 1 and 2), for which certification standards are evaluated adopted.

As concerns the relative advantage, recently (re-)certified forests and supply chains, using the two most comprehensive schemes would get full count towards a target, whereas any other certification scheme or older certification would be given (e.g.) a 10% discounting on the share of renewable energy or the crediting in the ETS. One possibility could be to make this system mandatory for energy producers using more than a certain amount annually or to link it to MS procurement rules in MS with more than a certain percentage of bioenergy in their energy system. For the purpose of assessing the tool for effectiveness and costs etc., a version applying to MS with more than 5% biomass in their energy system is taken forward. The percentage is purely indicative, and should be set based on more comprehensive analysis of impacts.

The system would require a regular (annual) comparison and ranking of certification schemes, which e.g. could be done by the established third party verifiers (such as e.g. DNV, Bureau Veritas or the like). The system would work somewhat similar to the credit rating system of countries, and could be funded either through collaborative donations, through a very small levy on all biomass used in the ETS or by mandatory contributions from a combination of industry

organisations. The approach would drive certification schemes to constantly improve (most are already, so no new obligation is established for these).

Notwithstanding this, the costs to the individual energy producer might increase slightly compared to the current situation, and administrative costs would be small and mostly in the inception phase. One advantage of the tool would be that eventual restrictions in supply would be phased in, as the certification schemes get more and more tight.

| Area | Justification | Score |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Cost for energy producer | The costs to the individual energy producer might increase slightly compared to the current situation, but would not become excessive as most energy operators already have substantial capacity in managing certified supply chains. More specifically, achieving COC certification will be a cost to producers. Also, additional, and likely greater investment will be required to assist in the development of certified fibre supplies. The cost to producer depends on the system that is used, based on the desired level of risk mitigation. The score is thus moderate. | Moderate (2) |
| Administrative burden | In the envisioned setup, the administrative costs to public administrations and the societal costs as such would be low. | Low (3) |
| Legal obstacles | The obligation to use certified wood only is found for biofuels already and should not pose any major obstacles. The part about establishing the ranking might contain some difficulties, not least in finding the right legal basis. However, defining the criteria for ranking of schemes would be controversial and difficult. In combination, the score is moderate. | Moderate |
| Policy coherence | Fares well with the current Biofuels regime and builds on existing schemes. Could have some relation to Biodiversity policies in the EU. Moderate score. | Moderate |
| Degree of innovation | Not a new tool in itself, however merging BAT with certification has not been tried before. Moderate score. | Moderate |
| Calculated Effectiveness Score | Moderate effect, combined with low administrative burden and moderate costs to operators, yield a score of 10 (Moderate effectiveness) | 10/moderate |

No go area tools

A *land use* no-go area definition that would include the mentioned ecosystems could direct demand to other source ecosystems. The process of defining ecosystems and identifying them in practice will be difficult. To avoid a *lex US*, ecosystem definitions used should be sufficiently generic to rules out similar ecosystems in e.g. Russia or indeed inside EU. On the other hand, vague or generic definitions would complicate the identification and open up for interpretation. A different road to take, would be to ruled out protected areas, however the findings of chapter 6 indicates that very little biomass is sourced from these lands if any. Down the same road, forests that are habitat to species on the

red lists of IUCN¹²⁹ could be designated no-go areas. This would require screening and reporting for all source forests at some cost, but could be worthwhile for further investigation.

It could be noted that in the understanding applied in this study, a no go area would not be able to cover e.g. longleaf pine as such, as these trees are found in many ecosystem and many sites. If a certain species were to be targeted, a negative list tool might be more appropriate.

A no-go area tool could also address a *land use change* such as loss of natural forest, e.g. by identifying plantations converted from natural forest since e.g. January 2008 (same date as in RE directive) as not eligible or banned. The cut-off date could have profound effect on the effectiveness of the tool, as a future date could drive speculative behaviour, whereas any date in the past would be arbitrary to some extent. A past date could also end up penalising old deeds, which would be counterproductive. Against this backdrop and for reasons of transparency and ease of administration the 2008 date could be kept.

Per definition, ruling out certain supply areas could lead to increased pressure on e.g. plantations, reinforcing other identified effects. In addition, leakage could result as US demand could be directed to these ecosystems, while biomass destined for EU demand would be sourced elsewhere. This intervention could build on the no-go areas identified in the RE directive, and if so administrative cost could be reduced and policy coherence increased. It would however, as with all negative list/no-go area intervention tools come with the challenge of agreeing on a clear, unmistakable definition, that can target the right type of forest both in the US, as well as in EU forests and potentially other wood pellet exporting countries.

In practice, both tools could be applied, by defining two separate types of no go areas, as done in the current Renewable Energy Directive.

| Area | Justification | Score |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Cost for energy producer | Establishing no-go areas on sourcing from specific ecosystems or forest types could increase the cost for energy producers as some (potential) supply is taken out of the system. Furthermore, some costs to ensure that biomass is sourced from areas outside of no-go areas is also foreseen. However, the change in cost compared to the baseline is expected to be moderate as large quantities of feedstock is still available. The costs are not expected to be great and are assessed to be medium in relation to other tools. | Moderate (2) |
| Administrative burden | Some administration is foreseen, as areas would have to be identified and compliance with the tool ensured. The burden is assessed to be medium. | Moderate (2) |
| Legal obstacles | Obstacles for implementation should be minor as the approach is well known from the RED, but high as the accuracy of the definitions of ecosystems or biomass types are decisive and difficult to get right. All in all the score is moderate | Moderate |

¹²⁹ <http://www.iucnredlist.org/about/introduction>

| | | |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Policy coherence | On policy coherence the land use change type of the tool scores high, as this would correspond well with, and support, a possible soft law initiative on reducing deforestation and the EUs commitments on REDD+. The land use version of the tool is rated medium, as it does support the Biodiversity Strategy, but not as explicitly. | Moderate |
| Degree of innovation | Establishing no-go areas on sourcing from specific ecosystems or forest types is not particularly innovative, as similar approaches have been used in other policy settings. Score: Low. | Low |
| Calculated Effectiveness Score | Moderate costs for producers and moderate administrative burden coupled with mitigation of effects translate into moderate effectiveness overall. | Moderate (8) |

Quota tools

Two possible quota tools are explored in more detail. Both tools aim at limiting the use of biomass in energy production, either through a quota for the energy operator or at a MS level.

Quota in the form of a cap on share of primary biomass wood pellets at energy producer level

A quota in the form of a cap on the share of energy produced from wood pellets at energy producer level would serve a broader purpose, addressing the driver directly. The quota should be targeted at wood pellets from primary biomass, so that secondary and tertiary biomass was still allowed. This would also support the principles of cascade use and the material hierarchy. In principle, the quota could be combined with no-go areas and negative lists to further limit the eligible amount of biomass.

The quota could be limited to large facilities or operators owning large facilities, or to entities falling under the EU Emission Trading Scheme. The downside of limiting the obligation to one or another subset of energy producers is the resulting risk of leakage, or the creating of two markets, where the amount of wood pellets marketed above the quota would be sold to private users or smaller entities. As a result, the effect of the quota would be reduced, as demand would not be reduced *per se*. Including all energy producers, on the other hand, could mean that non-commercial or smaller local plants would face rising supply costs and a significant administrative burden. One could therefore explore the option of a fast track or simple producer for smaller entities, where they would not have to document and verify the claims of the origin and type of biomass of the wood pellets used.

| Area | Justification | Score |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Cost for energy producer | A quota on the share of primary biomass wood pellets set at the energy producer level could significantly increase the cost for energy producers by limiting the amount of biomass wood pellets these producers could procure and thus increase the cost of renewable energy production. | High (1) |
| Administrative burden | Negative implications for the EU energy system in terms of costs and GHG benefits before 2020 are important and would need further assessment. The system would not as such require more administration, so all in all the score is set at medium. | Moderate (2) |

| | | |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Legal obstacles | The legal obstacles are not foreseen to be great, as the energy producers are regulated (and not the supplier of biomass), and other quota systems are already established within the EU. There could however be issues concerning the definition of wood pellets produced from primary biomass, as thinning, salvage logging wood etc. in principle should not fall under the cap. | Low |
| Policy coherence | The quota system aligns with other policies, e.g. the EU-ETS that functions by limiting the emissions allowed. | High |
| Degree of innovation | Quota systems have been used in several instances within and outside of the EU and the degree of innovation must be considered low. | Low |
| Calculated Effectiveness Score | Although this is an effective tool, the high producer and administrative costs means that this tool score moderate on effectiveness. | 9/Moderate |

Quota on MS share of wood energy in RES target

If a Quota based intervention tool was designed to constrain or limit the amount of wood pellets used for energy purposes at member state or EU level (for the period up until 2020) the increased demand in SE US would be addressed. Addressing the driver of the demand would help address all risks. By including all wood energy under the quota, the resource efficiency risk would also be addressed.

Implementing the quota at energy producer level, as described before, could put some producers in a difficult position, as no viable/cost efficient alternatives would be available. At MS level, policies could be implemented to support other RE sources, in order to meet the 2020 target.

| Area | Justification | Score |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Cost for energy producer | The cost depend on the MS implementation of the requirement, and whether support is given to compensate for the perceived higher costs of alternatives to wood energy. Again, it could have impact on the costs, whether a uniform quota is set for all MS, a different and negotiated one is set for each MS or whether it is a EU level quota (similar to the EU2030 RE target). The highest cost would be associated with the Uniform target for all MS, as alternatives vary from one MS to the other. However, as this variant is deemed not feasible for political reasons, an individual MS quota is used for the assessment of costs. This is set as medium. | Moderate (2) |
| Administrative burden | If the tool is implemented as an individual MS level quota, cost will vary among MS depending on which support measures are put in place if any. The system would not as such require more administration, so the score is set at low. | Low (3) |
| Legal obstacles | As said, there are several obstacles in terms of political feasibility for the design of this tool. It would be difficult to arrive at an individual quota for each MS that all together would address the risk at hand sufficiently. In addition, it would be difficult at first estimating the amount of biomass that could be extracted for EU use, while not compromising EU objectives. A specific quota for biofuels in transportation has been set under the Food Quality directive, which was no easy process. All in all the score is high. | High |
| Policy | The version of the Quota tool would ease the competition for wood | High |

| | | |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------|
| coherence | altogether, and could thus support bio economy strategies of EU and its MS As such the score is low however. | |
| Degree of innovation | A quota tool is well proven and tested throughout the years and thus scores low in innovation. | Low |
| Calculated Effectiveness Score | High effect paired with low administrative costs and moderate producer costs translates into high effectiveness overall for this tool. | 15/High |

In comparison, the quota tool implemented at energy producer level is associated with potentially high cost, as the resource base is restricted and a low cost fuel to some extent is made non-eligible. Strictly, the tool may result in higher compliance cost at societal level, for reaching the EU2020 RE target. The MS level quota tool targeted at limiting wood-based renewable energy at MS level is associated with high cost at societal level, but the individual energy producer may not face increasing cost if appropriate measures are taken at MS level. The administrative burden is found to be high for the two energy producer level quotas, as an energy producer level obligation would require verification and control. Measures could be taken to reduce this burden, e.g. if third party verifications would be foreseen. The MS level quota does not put administrative burdens on individual energy producers.

MAES compliant Natural Capital Accounting

A fundamentally different approach to addressing the risk would be Natural Capital Accounting¹³⁰ for (large) Energy Entities in the EU, based on the MAES work. This intervention would entail that energy producer's first map the components of natural capital¹³¹ within the land managed by the owner of the forest producing the biomass used for wood pellets used by the energy producer. By obliging, the producer to map the entire land area owned by the producer, cherry picking of certain forests for production to the EU is made less of an option. The mapping should follow the MAES approach based on the CICES typology (v4.3), which includes mapping three service themes:

- › Provisioning, which includes biomass production
- › Regulating and maintaining services, which includes soil formation and climate regulation (GHGs)
- › Cultural services

All of these are broken down into groups.

Further to the mapping, the Energy producer should follow the state of ecosystem service delivery for the land, and set up and maintain an NCA based account. The

¹³⁰ See <http://www.worldbank.org/en/topic/environment/brief/environmental-economics-natural-capital-accounting> and <http://unstats.un.org/unsd/envaccounting/seea.asp>

¹³¹ Sub-soil assets, abiotic flows and ecosystem capital, see MAES (2013), p.29

account could be relative to a baseline for the ecosystem services prior to the extraction of the biomass for the particular energy operator's wood pellets. The baseline would be set following an assessment of the conditions of the ecosystem(s) in accordance with principles for integrated ecosystem assessment, as drawn up in the MAES initiative (Science for Environment Policy, 2015; see figure 5 in that publication). The mandatory account could be considered constrained to wood pellets and wood chips (as opposed to all resources), to ease the reporting burden, but would cover global supply chains for the energy producer.

A part of the tool, or the governance of the tool, could be a threshold for use or loss of natural capital, where loss of habitat would count negative. A No Net Loss threshold would be one option, which would ensure consistency with that initiative. The MAES/NCA tool could be integrated with the NNL tool developed later in this text. In practice, respecting the threshold could work as an eligibility criterion for receiving financial support. An alternative threshold could be explored along the lines of a total natural capital cost with an estimated value of maximum 10 percent of total revenue of energy production.

A prerequisite for the NCA approach is to have valuations of the ecosystem services that could be used to make up the account. Forests and other woodland systems provide numerous ecosystem services, including provisioning, regulating and maintaining services, and cultural services. These service include fuel and fodder provision, water regulation (timing, quantity, and quality of water runoff) (Alcamo & Bennett, 2003), maintenance of soil quality (soil carbon stock, nutrient balance, soil biodiversity), protection against erosion and landslides, climate regulation (heat, evaporation, rainfall), habitats for species, and tourism and historical values. The services can be divided between direct values (e.g. timber, bioenergy), indirect values (e.g. water regulation, erosion control, carbon sequestration), option values (future economic options, including for bioenergy production) and existence values (e.g. landscape, religious, or aesthetic values) (Shvidenko et al., 2005).

| Area | Justification | Score |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Cost for energy producer | The system of MAES compliant NCA includes significant costs to energy producers as an entire mapping exercise would be needed before the assessment could be conducted. Data gathering and setting up of compliance systems/responsible experts at energy producers' organisation would all in all drive of costs to a high level at least in the initial phase. | High (1) |
| Administrative burden | To the extent that public authorities would have to approve and monitor MAES compliance systems by operators, administrative costs could be noteworthy. However, the tool builds on an initiative already planned by EU, requiring MS action, so additional administrative costs is rather small. Also, if third party verification could be foreseen driving down costs. The score is therefore low. | Low (3) |
| Legal obstacles | Establishing a legal basis under which MS or Energy producers would be required to monitor and account for loss (and gains) of ecosystem services in third countries could be challenging. The score is therefore high. | High |

| | | |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Policy coherence | The tool aligns with the CICES framework, the MAES approach under the Biodiversity Strategy and several other key EU policies and initiatives. | High |
| Degree of innovation | This tool is very innovative and novel and similar approaches have not been seen before. | High |
| Calculated Effectiveness Score | High producer costs and low administrative costs coupled with moderate effect means that the effectiveness of this tool becomes moderate. | 8/moderate |

No Net Loss of Ecosystem services

The concrete implementation of this tool could be to oblige EU energy operators (above a certain size, e.g. 20 MW or all energy entities in the EU-ETS) to monitor the ecosystems that deliver the (primary and secondary) biomass being used to produce the wood pellets used by that entity. Compared to the MAES/NCA tool there should be given more flexibility and less demanding reporting requirements, so as to justify a less comprehensive and presumably less effective tool.

The obligation would apply to both ecosystems inside and outside of EU. The obligation would further concern a No Net Loss obligation for the energy entity as a whole (or at least its energy producing business units). In practice, this would imply that for every detected loss of biodiversity (in an event of land use change or changed management of the ecosystem) the company would have to offset this loss with comparable restoration of biodiversity at a similar location. In principle, the NNL tool could be combined with the MAES tool, so that all mapping of ecosystem services should be consistent with the MAES typology and framework.

| Area | Justification | Score |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Cost for energy producer | Quite similar to the MAES tool, the NNL tool includes significant costs to energy producers as an entire mapping exercise would be needed before the assessment could be conducted. Data gathering and setting up of compliance systems/responsible experts at energy producers' organisation would all in all drive of costs to a high level at least in the initial phase. | High (1) |
| Administrative burden | To the extent that public authorities would have to approve and monitor MAES compliance systems by operators, administrative costs would be medium. If not, or if third party verification is foreseen, administrative costs would be lower. As the NNL initiative is planned and MS action is needed, few costs would be additional. The score is low. | Low (3) |
| Legal obstacles | The whole concept of comparable and similar ecosystem services are fraught with definitional issues and challenging conceptualisation. This adds to the same challenges as for MAES and thus the score is high. | High |
| Policy coherence | The tool could align with the proposed NNL initiative, and yield synergies for MS that themselves would have to respect the 2020 target of no net loss of biodiversity. Furthermore, extending this principle to some global supply chains would show the commitment of EU to tackle loss of biodiversity. The score is high. | High |

| | | |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------|
| Degree of innovation | This tool is very innovative and novel and similar approaches have not been seen before. The score is high. | High |
| Calculated Effectiveness Score | High producer costs and moderate administrative costs coupled with low effect means that the overall effectiveness becomes low. | 4/Low |

The below Table 8-13 holds the identified intervention tools, ranked after suitability to address the implication, based on expert judgment.

Table 8-13. Options

| ID | Intervention tool | Effectiveness | Strength | Weakness |
|----|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 1a | Certification | Score: 10 (Moderate) Moderate producer costs, combined with low administrative costs and moderate effect (as it mitigates the risk) leads to moderate effectiveness. | + Systems adopted and well-integrated between producers and end users + Support and alignment with public/stakeholders well understood + Existing systems, familiarity and expertise within the region | ÷ Certification systems differ in level of risk reduction, which needs to be incorporated into a ranking system |
| 1b | No-go area | Score: 8 (Moderate). Moderate costs for producers and moderate administrative burden coupled with mitigation of effects translate into moderate effectiveness overall. | + Able to target source ecosystems subject to the effect | ÷ Not able to target certain biomass types ÷ Potential issues on definition of biomass/ecosystem etc. ÷ Potential issue on leakage |
| 1c | Quota at producer level | Score: 9 (Moderate) Although this is an effective tool, the high producer and administrative costs renders this tool moderate on effectiveness. | + Small leakage effect + Able to address the driver behind several effects and thus implications | ÷ Potential negative impact on cost efficiency in EU ÷ High producer costs |
| 1d | Quota on MS share of wood energy | Score: 15 (High) High effect paired with low administrative costs and moderate producer costs. This translates into high effectiveness overall for this tool. | + Small leakage effect + Address the driver directly + Few administrative costs | ÷ Possibly negative impact on cost efficiency of RE targets ÷ Political feasibility of agreeing MS level targets low |
| 1d | MAES-NCA | Score: 8 (Moderate) High producer costs and low administrative costs coupled with moderate effect means that the effectiveness of this tool becomes moderate. | + Broad coverage of natural capital incl. carbon stock + High level of policy coherence | ÷ Potential issues on administrative costs ÷ High costs for producers and possibly for administrations as well |
| 1e | No net Loss | Score: 4 (Low). High producer costs and | + Simple tool, with high level of policy coherence | ÷ High producer costs ÷ Low effect, as it targets |

| | | | | |
|--|--|---------------------------------------------------------------------------------------------------------|----------------------------|------------|
| | | moderate administrative costs coupled with low effect means that the overall effectiveness becomes low. | + Low administrative costs | offsetting |
|--|--|---------------------------------------------------------------------------------------------------------|----------------------------|------------|

8.4.6 Ideal tools to address risk 3: Reduced Resource Efficiency and Circularity

Material hierarchy requirement

A possible demand side tool that address material competition directly is the Claim of Economic Interest implemented in Belgium. Industries or sectors, based in US or EU, that could substantiate claims of conflicting interest in a certain fraction of biomass from a certain origin, could file this claim with the Commission. This claim, if approved would result in an exclusion of biomass from State Aid or status as waste or residue for a defined period (e.g. two years or while the claim can be substantiated), if used for energy purposes. The tool would require transparent procedures and criteria for when such claims should be approved, which in itself could be a potential issue. One criteria for consideration would be that the alternative use (the claimants use), would deliver higher economic value for society. Such a tool could support the cascade use and circular economy objectives.

| Area | Justification | Score |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Cost for energy producer | The costs for energy producers are moderate, as there are no new reporting requirements or other obligation imposed on them, however the available resources may decrease, pushing them to procure more expensive materials elsewhere. | Moderate (2) |
| Administrative burden | While the exact design of the tool is quite open, it could entail some administrative burden for public administrations if all biomass types were to be assessed for market value regularly. However, this is a one off assessment, which could be substantiated by market data and research, just as third parties could be involved. The score is therefore moderate. | Moderate (2) |
| Legal obstacles | Legal obstacles has been found to be minor, as it is expected the Belgian experiences could be built on. | Low |
| Policy coherence | The material hierarchy requirement could deliver significant synergies with the expected circular economy package (COM(2015)614/2). | High |
| Degree of innovation | This type of tool has not been used in a bioenergy context other than in Flanders, and thus scores high on innovation. | High |
| Calculated Effectiveness Score | The tool is effective, and with moderate administrative costs and producer costs this translate into high effectiveness overall. | High/12 |

Quota tool

A production or waste wood quota tool has been assessed for the previous risks. To address material competition a quota tool could be applied as well, if targeted at specific biomass types subject to material competition. For example a quota specifying the share of waste wood (defined as wood with no economic value) used in wood pellets in-fired in an installation receiving support would drive Energy producers to develop sourcing strategies for this material. The quota could be implemented progressively, so that the mandatory share would increase towards a given year, e.g. 2030. The quota should apply to total amount of wood pellets over a year, on not on individual consignment level. Currently, it is uncertain whether sufficient waste wood is available in the market and at what cost (cleaning, preparation, critical mass etc.) and such aspects would have to be investigated further.

| Area | Justification | Score |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Cost for energy producer | As such, the quota would render a significant resource based non-eligible for European energy operators, and would drive them towards more expensive supplies. As the collection systems may not be in place, and the resource base could be insufficient in the short term, costs are expected to be high. | High (1) |
| Administrative burden | To the extent that government controls would be required, some costs could be expected. If only spot checks are used and/or if third party verification was required, administrative costs would be small. However, as much of the biomass supply would be rendered ineligible, cost to society may increase. The score is therefore moderate. | Moderate (2) |
| Legal obstacles | The legal obstacles could be significant (high) for the energy producer level quota for waste wood, as it will be difficult to define waste wood, thus manage, and comply with afterwards. | High |
| Policy coherence | As concerns policy coherence, the waste wood quota, scores high as it would directly support the circular economy and cascade use agenda. | High |
| Degree of innovation | As with the quota tools addressing risks 1 and 2, there innovation score is low. Quotas have been used multiple times before. | Low |
| Calculated Effectiveness Score | High producer costs and moderate administrative burden, coupled with a high effect, means that the overall assessment translate into moderate effectiveness. | 9/Moderate |

Positive/Negative list

As a third option for further assessment, a modified version of the positive and negative list could be envisioned, drawing on the material hierarchy tool. This version would, different from the Dutch implementation, include a formulation excluding wood pellets produced from material with alternative, higher economic value use, from support, paired with a positive list of biomass types not considered subject to material competition. The positive list could contain the same biomass types as included in the Flemish material hierarchy tool:

- › Bark

- › Dust (sanding dust, filter fabric, mesh fabric, fabric cutter MDF) with particle size smaller than 0.2 mm
- › Fine prunings with a diameter smaller than 4 cm
- › Twigs from forest canopy with a diameter smaller than 4 cm
- › Stumps up to a maximum of 30 cm above ground level
- › Other wood flows, which relevant industry organizations declare, they do not use as industrial raw material use.

This tool could be less administrative, as the definition of higher economic value use could be established by an economic analysis and consolidated into a guidelines or indeed legal text. It would thus be less dynamic and flexible, which again could mean higher cost for energy producers.

| Area | Justification | Score |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Cost for energy producer | Increased cost for energy producers can be expected if the definitions are too tight so that the resource base available is significantly reduced and higher cost biomass are to be sourced. Setting up a negative list banning specific biomass types and other high value material can increase the cost for bioenergy producers for some of the same reasons as no-go areas. The score is medium as this risk and the concrete tool is uncertain and dependent on other issues. | Moderate (2) |
| Administrative burden | Administrative burden is low as no major change is expected relative to the current situation were Energy Producers to a large and increasing extent use certified biomass. It is taken into consideration that some administrative costs are foreseen, as areas would have to be identified and compliance with the tool ensured, this is already the case. | Low (3) |
| Legal obstacles | Legal obstacles are perceived high as the approach depend on clear definitions that allow for sorting compliant biomass types from non-compliant or target the intended ecosystems without excluding ecosystems not associated with the risk. Such definitions can be difficult to agree. In addition, obstacles in relation to compliance with WTO must be ensured and a Lex US must be avoided. | High |
| Policy coherence | Some policy coherence can be found with this tool, as it could be coupled with the no-go areas tool or quotas. | Moderate |
| Degree of innovation | Setting up a negative list is somewhat novel in that it takes an existing policy approach and modifies it to the given situation, but the tool type is not new. | Moderate |
| Calculated Effectiveness Score | The tool is effective, and the moderate administrative and producer costs means that the overall effectiveness of this tool becomes high. | 12/High |

Table 8-14. Shortlisted intervention tools for risk 3.

| Option ID | Intervention tool | Effectiveness | Strength | Weakness |
|-----------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 3a | Material hierarchy requirement | Score: 12 (High). The tool is effective, and with moderate administrative costs and producer costs this translate into high effectiveness overall. | + Specific to biomass types and sources with conflicting interest Synergies the circular economy/cascade use agenda + Experience to build on, available from BE | ÷ Introduces potential supply uncertainty for Energy Producers ÷ Potentially difficult administration for COM |
| 3b | Quota on waste wood | Score: 9 (Moderate). High producer costs and moderate administrative burden, coupled with a high effect, means that the overall assessment translate into moderate effectiveness. | + Could be made specific to relevant biomass types subject to competition + Support cascade use and circular economy objective | ÷ Uncertain if sufficient waste wood is available to support a quota of an adequate size ÷ Potential issues on definitions |
| 3c | Negative list | Score: 12 (High). The tool is effective, and the moderate administrative and producer costs means that the overall effectiveness of this tool becomes high. | + Simpler management + Able to target driver of material competition + Able to target source ecosystem + Able to target specific biomass types | ÷ Low flexibility ÷ Potential issues on definition of biomass/ecosystem etc. ÷ Potential issue on leakage |

8.4.7 Possible tools to address risk 4: Non-attainment of GHG benefits

The risk that increased EU reliance on wood pellets from SE US will lead to implications for US forests that again result in wood pellets not being able to deliver GHG benefits as intended is supported by less clear evidence, compared to the three other risks. While these issues remain, the development of tailor-made tools to address risk 4 cannot be as detailed as for the other risks, and the assessment of effectiveness is not possible, as the evidence and modelling did not provide a clear baseline. The possible tools in the following section have been constructed to address the risk to level of detail possible in light of these constraints, but have not been assessed for effectiveness.

Both being put forward and assessed as a tool, one can note that the regulation implemented in the State of Massachusetts, partly in response to the Manomet study (see 5.3.2) (Walker et al., 2010), does address a number of the implications following from the increased EU demand. It does not apply to the whole southeast US, but the findings are relevant to this region as well. In Massachusetts a pseudo-precautionary approach has been adopted, where biomass fuels are only eligible if

the origin of the fuel is tracked and if the following “eligible biomass fuels”¹³² are used: forest derived residues, forest derived thinnings, forest salvage, non-forest derived residues, or dedicated energy crops. As current EU imports from the southeast is dominated by wood pellets based on dedicated pulpwood (about 60-75%, mostly softwood pulpwood, but also hardwood pulpwood (Iriarte et al., 2014; RISI, 2015c)), most of this would not pass the eligibility criteria unless it originated from thinnings. The state has also taken steps to provide additional incentives to reward efficiency improvements, such as favouring combined heat and power generation versus less efficient stand-alone electric power generation or co-firing. A similar approach could be adopted in the US Southeast or in EU pertaining to e.g. imports, and would counter some of the problems related to very long (several centuries) carbon payback periods associated with some biomass sources, e.g. Roundwood from old growth forest. However, this does not counter problems related to leakage and biomass substitution effects.

Modified RED GHG impact formula

The current formula from annex V part C of the RED includes factors corresponding to each step in the value chain of wood pellets. Correspondingly, the formula includes a factor that covers emission from cultivation of the feedstock but not the carbon in the harvested wood (incl. residues). This is intentionally left out, as this carbon is assumed immediately re-sequestered into the biogeochemical carbon cycle via plant growth, which is a fair assumption for crops with annual or short rotation. Some forest biomass types, such as those included in the NL negative list (e.g. timber with rotation >40 yrs.) cannot fulfil this assumption. Furthermore, this does raise the issue of clearly identifying and categorizing biomass types in legislation. Therefore, introducing a factor into the calculation that reflects the carbon taken out of a given forest during harvest would internalise the cost of depleting carbon stocks. The introduced factor should include the carbon (in gCO_{2eq}), taken out of the forest. Ideally, this would be modified by a factor for the rotation length of the stand, e.g. using the inverse rotation length in years: $Carbon\ content * (1 - 1/rotation\ length\ in\ years)$. No solid approach for this has however been identified yet. Furthermore, the tool cannot internalise indirect effects (e.g. indirect land use change (ILUC) and indirect wood use change (IWUC) etc.) unless a factor is developed and added.

This concrete development of this tool depend on the development of these two factors. A great deal of work has been put into clarifying the GHG benefits of various bioenergy systems, and some of this work include proposed calculation methods. A more in-depth analysis of various approaches would be needed before the tool could be made more concrete.

The implications of this intervention tool on e.g. standard practice for calculation of GHG impact for compliance towards the EU2020 RE and Emission Reduction target could be prohibitive in terms of cost and administration, and there would be significant legal obstacles related to agreeing on a calculation approach for both factors.

¹³² These are further defined in the regulation.
<http://www.mass.gov/eea/docs/doer/renewables/biomass/225-cmr-14-00-final-reg-doer-081712-clean-copy.pdf> Additional details on the Massachusetts policy process can be found here:
<http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/biomass/>

**Project based
accounting tool**

With this tool, the source region is the project area and the time window is the duration of the project. Any EU energy operator wanting to use wood pellets (e.g. in the ETS) would be required to calculate the impact of the demand satisfied by the sourcing region using appropriate CDM or JI methodologies. There are existing methodologies for afforestation projects and for biomass/bioenergy projects (and a wealth of other project types), but no integrated methodology for sourcing of biomass for wood pellet production. Such a methodology would have to be developed first.

Following UNFCCC methodologies, the assessment of the project takes place ex-ante, and is then followed up on, on a yearly basis. In the ex-ante assessment, alternative scenarios have to be developed and assessed, and barriers for development of the alternative scenarios are to be identified and assessed. Such barriers include¹³³:

- > Investment
- > Institutional
- > Technological
- > Local tradition, social, land tenure/ownership
- > Ecological conditions
- > Local prevailing practice

These elements would be incorporated into the tool, so that supply chains would have to be assessed beforehand. Any energy producer would then have to present a report per supply chain, which should document that no negative GHG impact results from the sourcing of the biomass. This work could drive of administrative costs.

The tool would have synergies with existing UNFCCC and (if continued after COP21) Kyoto Protocol based GHG accounting and could thus inform MS and EU reporting and accounting, which again would increase transparency on accounting for biomass (currently an aggregated memo item in the energy sector reporting). Opposite, the project-based approach would not be consistent with current reporting following the rules in the Renewable Energy Directive, which could lead to some extra costs on reporting for energy entities. The ex-ante report would in many ways cover issues included in existing certification schemes, but the schemes are not consistent with UNFCCC methodologies for calculating GHG benefits, if included at all.

No full assessment of effectiveness and costs are given for either of the tools for risk 4 due to the uncertainties linked to both the risks and the possible tool design. Notwithstanding this, an overview of the two tools is given below.

¹³³ <https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf>

| Option ID | Intervention tool | Effectiveness | Strength | Weakness |
|-----------|---------------------------------|----------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| 4a | Modified RED GHG impact formula | <i>Not evaluated</i> | + Extending existing practice and relying on existing reporting | ÷ Significant legal/definitional issues |
| 4b | Project based accounting tool | <i>Not evaluated</i> | + Consistent with MS/EU GHG reporting + Increase transparency on biomass use | ÷ High costs for operators ÷ Complex and resource demanding procedures |

8.4.8 Overview of effectiveness of tools

The tools has been assessed for effectiveness in addressing the risks:

Table 8-15. Assessment of effectiveness in addressing the risks. Effectiveness is based on expert judgment, and high is scored for tools that target the risk and nothing else, address the driver behind the effect causing the implication leading to the risk. Medium is given if only one of these criteria is fulfilled, and low if none. Only risk-tool combinations identified in the previous sections have been rated.

| Ideal intervention tool | Risk 1: Loss of habitats | Risk 2: Loss of forest | Risk 3: Material Competition | Risk 4: Non-attainment of GHG benefits |
|-------------------------------------------------------------------------|--------------------------|------------------------|------------------------------|----------------------------------------|
| Certification | Moderate | Moderate | | |
| No go area on sourcing from specific ecosystem/forest types | Moderate | | | |
| No go area on land use change | | Moderate | | |
| Quota on share of primary biomass wood pellets at energy producer level | Moderate | Moderate | | |
| Quota on MS share of wood energy in RES target | High | High | | |
| MAES NCA accounting | Moderate | Moderate | | |
| No Net Loss of Ecosystem Services | Low | Low | | |
| Material Hierarchy requirement | | | High | |
| Quota on share of waste wood in wood pellets at Energy Producer level | | | Moderate | |
| Negative list banning specific biomass type/high value material | | | High | |
| GHG impact formula | | | | NA |
| Project Based Accounting Tool | | | | NA |

The targeted measures are given a high effectiveness in general, and hence expectedly a combination of tools would be necessary to address all risks.

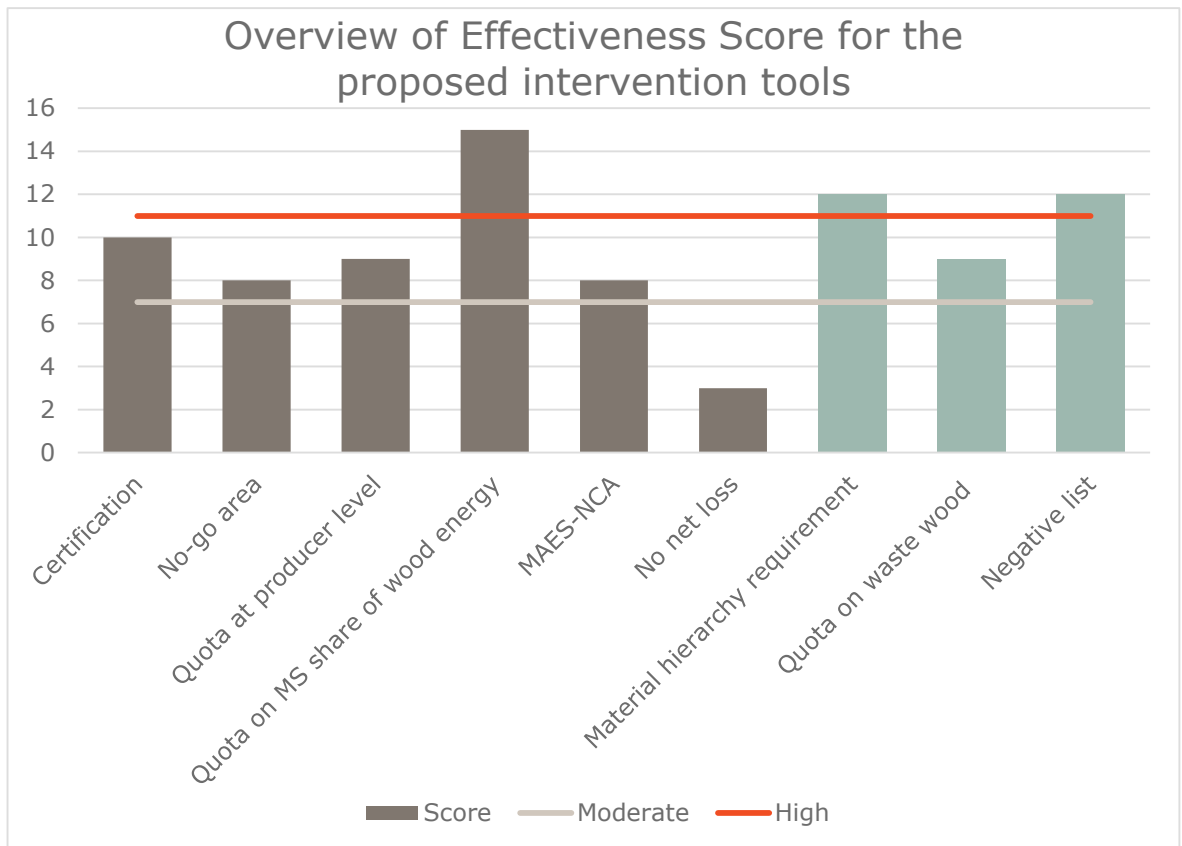


Figure 54. Overview of Effectiveness Score for the proposed intervention tools. The six tools to the left address objectives 1 and 2, while the three tools to the right address objective 3. The grey line indicates the threshold above which tools are classified as having moderate effectiveness (>7). The red line indicates the threshold above which tools are classified as having high effectiveness (>11).

The effectiveness score of the tool are shown above. For objectives 1 and 2, one tool show low effectiveness (no net loss), four tools show moderate effectiveness (Certification, no-go area, quota at producer level, and MAES-NCA), while one tool (Quota on MS share of wood energy) show high effectiveness. For objective 3, two tools (material hierarchy requirement and negative list) show high effectiveness, while the quota on waste wood tool show moderate effectiveness. The average effectiveness score is 9.5, and the tools score from 3 (No net loss) to 15 (Quota on MS share of wood energy).

8.4.9 Overview of characteristics of tools

In summary, the assessment of *ideal* options to address the individual risk produced the below assessments.

Table 8-16. Summary of assessment of options. Cost refer to cost for energy producers currently using wood pellets. Administrative burden refers to public administrations. Legal obstacles can be inconsistent with existing practice, inconsistent with existing intervention tool, and difficulties related to regulating the matter, e.g. if definitions are essential but difficult to agree/settle. Policy coherence means whether the policy action would support other policy action planned or ongoing, not directly related to bioenergy/renewable energy. Red colour is negative and green positive.

| Ideal intervention tool | Cost for energy producer | Administrative burden | Legal obstacles | Policy Coherence | Innovative |
|-------------------------------------------------------------------------|--------------------------|-----------------------|-----------------|------------------|------------|
| Certification | Moderate | Low | Moderate | Moderate | Moderate |
| No go area on sourcing from specific ecosystem/forest types (land use) | Moderate | Moderate | Moderate | Moderate | Low |
| No go area on sourcing from deforested areas (land use change) | Moderate | Moderate | Moderate | High | Low |
| Quota on share of primary biomass wood pellets at energy producer level | High | High | Moderate | Moderate | Low |
| Quota on MS share of wood energy in RES target | Low | Moderate | Moderate | Moderate | Low |
| MAES/NCA accounting | High | High | High | High | High |
| No Net Loss | High | Moderate | High | High | High |
| Material Hierarchy Requirement | Moderate | High | Low | High | High |
| Quota on share of waste wood in wood pellets at Energy Producer level | High | Moderate | High | High | Low |
| Negative list banning specific biomass type/high value material | Moderate | Moderate | High | Moderate | Moderate |
| Modification of GHG impact formula | High | Low | High | High | Low |
| Project Based Accounting tool | High | High | Low | High | Moderate |

8.5 Chapter summary

Based on the review of existing legislation and EU commitments to international treaties a total of four policy objectives was identified, namely

- › 1. *Protect and improve (global) biodiversity.*
- › 2. *Halt (global) deforestation and degradation*
- › 3. *Ensure optimal use of wood resources*
- › 4. *Obtain GHG benefits form the use of solid biomass for energy production*

The thesis of this study is that if any of the effects identified in forest or forest markets in Southeast US can compromise the achievement of (part of) any or all of the objectives, then increased reliance of the EU on solid biomass imported for energy purposes from this region can pose a policy risk to the EU.

Therefore, the first assessment concerns the likelihood and magnitude, which each of the four effects potentially could have on the achievement of the objectives analysed through a number of environmental indicators. The effects are:

1. Forest type conversion from natural forests to plantations
2. Intensification of management and harvesting
3. Increased pressure on forests of high biodiversity value
4. Displacement of existing wood users and possible indirect effects

It is found that the effects could compromise the achievement of objectives 1, 2 and 3, and with potentially objective 4, although less evidence was found. The resulting policy risks are therefore all characterised, and it is found that none are temporary, and all could become more relevant in the future.

Table 8-17. Overview of tools.

| ID | Intervention tool | Mitigation hierarchy | Risks addressed | Calculated Effectiveness Score |
|----|-------------------------------------------------------------------|------------------------|-----------------|--------------------------------|
| 1a | Certification | Mitigate | Risk 1 and 2 | Moderate |
| 1b | No-go areas | Mitigate | | Moderate |
| 1c | Quota on primary biomass in wood pellets at energy producer level | Avoid | | Moderate |
| 1d | Quota on wood based RES at MS level | Avoid | | High |
| 1e | MAES/NCA | Mitigate (and restore) | | Moderate |
| 1f | No Net Loss | Off set | | Low |
| 3a | Material hierarchy requirements | Avoid | Risk 3 | High |
| 3b | Quota on waste wood | Avoid | | Moderate |
| 3c | Positive/negative list | Mitigate | | High |
| 4a | Modified GHG impact formula | Mitigate | Risk 4 | Not Assessed |
| 4b | Project Based Accounting Tool | Mitigate | | Not Assessed |

Based on this assessment, it is found that legal action can be justified at this stage for risk 1, 2 and 3. Therefore action could be taken, at least to address loss of habitats, biodiversity and forests, and to prevent suboptimal resource efficiency. Action could also be taken to address non-attainment of the perceived GHG benefits from use of biomass for energy purposes, however the signal and evidence is not sufficiently clear to establish a baseline, and thus it is difficult to determine what kind of tool would be most effective and appropriate. The list of tools are found above.

Due to several similarities, risks 1 and 2 are sought addressed by the same tools, and six possible tools are identified via screening of existing literature and legislation, as well as planned initiatives by the EU. The tools vary in nature, and no clear favourite is found. Rather a group of tools are found to be moderately cost efficient, mainly so because moderately effective tools are moderately to highly costly. No tools are found to have high cost efficiency, due to the fact that only one of the tools (quotas) directly address the driver, being EU demand. The quota tools however are associated with high costs.

Risk 3 is addressed with three tools, all scoring moderate on effectiveness. For Risk 4, two possible tools are outlined; however, these are not assessed for effectiveness due to an unclear baseline and less strong evidence.

In summary, this chapter does not highlight or recommend one or more tools and does not propose a policy scheme or initiative. It merely assesses a number of interventional tools in order to facilitate further discussion and exploration of possible EU Action on environmental implications resulting from increased EU reliance on biomass for energy imported from Southeast US.

Appendix A List of References

- › 1999/C56/01 Council Resolution on a forestry strategy for the European Union, [http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31999Y0226\(01\)&from=EN](http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31999Y0226(01)&from=EN)
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Appendix B Overview of states in the Southeastern US

Virginia

Forest statistics

As of 2013, 63% of Virginia is forested (15.9 million acres of forestland). Upland hardwoods comprise 61% (9.7 million acres) and loblolly and shortleaf pine occupy 19% (3 million acres) of which 70% is pine plantations. Between 2011 and 2013 timber volume across Virginia increased by 2.7%, with a 2.5% increase in growth being accompanied by a 5.4% decrease in timber harvests across the state (Rose, 2015a). Most (76%) of the volume increase was in hardwoods. Most of the removals (nearly 50%) occurred in softwood, most of which is plantation pine.

Most forestland in Virginia is privately owned (82%). In 2001 corporations owned just over 1 million acres and in 2011 this fell to 196,000 acres and then 188,400 acres in 2013. The total area of forestland in the state increased between 2011 and 2013 but there were losses in the southwest, south central, and the southeast Coastal Plain regions of the state. With more than half a percent of the forest area in the Coastal Plain being lost to other land uses between 2011 and 2013 (Rose, 2015a).

| | |
|-----------------|-------------------------------------------------------------------------------------------------------------------------|
| | http://www.teaming.com/wildlife-action-plan/virginia |
| Virginia | http://www.forestationplans.org/states/virginia |

Policy framework

In Virginia there are 17 state agencies involved with laws that influence forestry, more than any other southern state. Virginia has two main state laws at the state-level which apply to forest management. At the local jurisdiction level other statutes exist (e.g. zoning codes and ordinances) that are not reported on here. Virginia code relating to forestry specifies a system of harvest notification, inspection, and compliance intended to help ensure BMPs¹³⁴ are properly implemented. The second law applies to the regeneration of pine.

Building from the Federal Clean Water Act, Virginia state law (VA Code Title 10.1. Chap.11. §. 81.1 - 81.7.71.) requires that loggers and landowners notify the Virginia Department of Forestry prior to completing a harvest, but not later than three days after commencement of timber harvesting activities. Notifications can be either verbal or written and must specify the date and location of harvesting activities. A fine may apply if landowners and loggers fail to comply. The Virginia Department of Forestry reports that every operation they receive notification about

¹³⁴ Virginia's BMPs: http://www.dof.virginia.gov/print/water/BMP/Manual/2011_Manual_BMP.pdf

is inspected as well as those that are discovered that they have not been notified about. If infractions are found the Department has the authority to order corrective actions. If not implemented, the Department also can order operations to cease and desist. Injunctions and fines can follow if necessary. The notification system was enacted in 1998 but was not made an enforceable requirement until 2004. From when it was enacted in 1998 to 2003 17,853 harvest notifications were recorded and the state inspected 20,217 harvests (Ellefson et al. 2004). Overall the notification system resulted in about 360 compliance actions (e.g. correcting BMP implementation) initiated each year over the last decade. Overall, incidences of failure to notify have decreased in part due to extensive education about this regulatory approach offered through Virginia’s SHARP Logger program.

Table 8-18. Virginia harvest notification system between 2004 – 2013

| Harvest Year | Number of Timber Harvests | Number of Harvested Acres | Compliance Actions | Failure to Notify Violations |
|--------------|---------------------------|---------------------------|--------------------|------------------------------|
| 2004 | 5,015 | 183,097 | 535 | 140 |
| 2005 | 5,540 | 209,699 | 447 | 96 |
| 2006 | 4,706 | 196,687 | 374 | 90 |
| 2007 | 5,463 | 229,423 | 552 | 101 |
| 2008 | 5,071 | 241,328 | 393 | 92 |
| 2009 | 4,538 | 219,909 | 323 | 61 |
| 2010 | 4,828 | 173,648 | 290 | 57 |
| 2011 | 5,905 | 248,165 | 268 | 37 |
| 2012 | 5,777 | 239,827 | 201 | 48 |
| 2013 | 5,658 | 233,714 | 229 | 34 |
| 2014 | 5,578 | 232,344 | 333 | 22 |

There is a seed tree law in Virginia (VA Code Title 10.1. Chap. 11.§. 64, 65 and 71.) Administered by the Virginia Department of Forestry that specifies for naturally regenerating pine, people owning and harvesting loblolly pine or white pine on parcels of 10 acres or more consisting of 25% or greater of those species (i.e. pine plantations) shall leave uncut no less than eight mature cone-bearing trees at least 14 inches in diameter on each harvested acre. If eight cone-bearing pine trees of 14 inches or larger are not present then two cone-bearing trees of the next largest diameter need to be left in place of a 14 inch diameter tree that is not present. Seed trees may not be cut until three or more years after harvest. Persons violating this law face criminal penalties (misdemeanor) and may be fined \$30 for each seed tree cut, but not to exceed \$240 per acre. Provisions of this law do not apply to ownerships in excess of 500 acres (i.e. industrial lands or large NIPF ownerships) or landowners receiving federal financial assistance for timber growing. Virginia Code§29.-563-570 serves to reinforce the federal ESA by inflicting criminal charges through the state judicial system on persons violating federal protections for T&E species. In Virginia, state wetlands laws are arranged to reinforce federal laws as described in chapter 3

Table 8-19. Number and type of programs in operation at the state level in Virginia that influence forestry practices as of 2007.

| Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| 9 | 3 | 2 | 8 | 1 | 6 |

Table 8-20. Percentage of time that various BMPs were implemented in Virginia as reported by state forestry agencies.

| Year of survey | Overall BMP Implementation Rate | Harvesting | Forest Roads | Stream Crossings | SMZs | Site Prep. | Firebreak | Chemical App. |
|----------------|---------------------------------|------------|--------------|------------------|------|------------|-----------|---------------|
| 2007 | 75% | 78% | 70% | 77% | 82% | 60% | NA | NA |
| 2008 | 82% | 79% | 79% | 81% | 81% | NA | 68% | 100% |
| 2009 | 82% | 82% | 75% | 83% | 86% | 80% | 70% | 88% |
| 2010 | 83% | 85% | 74% | 82% | 86% | 81% | 74% | NA |
| 2011 | 86% | 86% | 78% | 87% | 91% | 81% | 76% | NA |

Source: Adapted from Shepard, 2006; Southern Group of State Foresters, 2012

North Carolina

Forest Statistics

As of 2012, forests covered 60% (18.6 million acres) of North Carolina, estimated to have increased by 38,600 acres since 2007. Upland hardwoods comprised 41% (7.8 million acres), loblolly and shortleaf pine occupied 30% (5.48 million acres), bottomland hardwoods comprised 10% (1.81 million acres), and longleaf pine was present on 1.7% of timberland (320,000 acres) (Brown et al. 2014).

Pine plantations represented 18% (3.2 million acres) of North Carolina's timberland in 2012, with the Coastal Plain containing 75% percent of the planted acres, the Piedmont 23%, and less than 2% in the mountains of western North Carolina (Brown et al. 2014). Overall eastern North Carolina contains the most forestland.

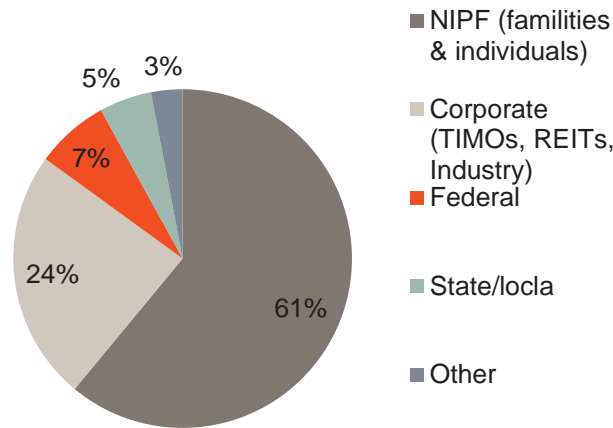


Figure 55.

About half a million NIPF owners make up the bulk of the private forestland in the state. Much of the corporate owned land in is in the eastern part of North Carolina in the loblolly pine plantations of the Coastal Plain. Between 2007 and 2012 timber volume across North Carolina increased by 6%, with average annual net growth increasing by 11.4% and average annual timber harvests during this same timespan decreasing by 15.2% (Brown et al. 2014). Hardwood comprised 65% and softwoods 35% of the total inventory in 2012. Most hardwood removals over this timespan occurred in the piedmont. Removals were less than growth in the plantations of the Coastal Plain with 68% of the net growth in softwoods occurred in the pine plantations of the coastal (Brown et al. 2014).

| | |
|----------|-------------------------------------------------------------------------------------------------------------------------------------|
| North | http://www.teaming.com/wildlife-action-plan/north-carolina |
| Carolina | http://www.forestationplans.org/states/north-carolina |

Policy framework

North Carolina’s policy framework regulating forest management activities tiers mainly from the federal Clean Water Act. Specifically, the North Carolina Sedimentation Pollution Control Act of 1973 (NCSPCA)¹³⁵ is meant to control sediments pollution of surface waters of the state. Under this law certain land disturbing activities (e.g. construction of buildings) require a state administered permit, while forestry is exempt. Under this law land clearing operations which may involve timber harvests, but are intended to facilitate a change in land use, are differentiated from silviculture and such land clearing operations may require an approved sediment and erosion control plan (NC Forest Service, 2014).

¹³⁵http://www.ces.ncsu.edu/depts/agecon/WECO/franklinco/documents/SedPollControlAct1973_w2007ammends.pdf

In the NCSPCA forestry activities are exempt from the need to develop a sediment and erosion control plan as long as forestry operations are deemed by the North Carolina Forest Service (NC Forest Service) to be in compliance with North Carolina's Forest Practices Guidelines Related to Water Quality¹³⁶ (FPGs). The FPGs are intended as performance standards for forestry operations upon which the North Carolina BMPs¹³⁷ are based.

The NC Forest Service is delegated the authority to monitor compliance of the FPGs, providing site inspections and technical assistance to landowners and loggers with the implementation of BMPs. Unlike Virginia, North Carolina does not require a notification system.¹³⁸ Rather, harvest operations are selected for compliance inspections in these instances:

- › Active or recently completed harvests are identified directly at the county-level by NC Forest Service field foresters and by NC Forest Service water quality technicians who provide technical assistance to landowners. These state employees are charged with monitoring compliance.
- › The NC Forest Service also surveys forest conditions from airplanes and this does include occasional identification of timber harvesting sites.
- › State and /or federal cost-share assistance for forestry activities (e.g. management plan development or pre-commercial thinning) often requires harvest inspection.
- › If there are citizen complaints that harvesting operations are degrading waters the NC Forest Service will complete an inspection.
- › The NC Forest Service also completed inspection as requested by timber buyers (this may include pellet mills), loggers, or upon the request of landowners.

If inspections reveal that BMPs are not properly implemented, or if there is some other non-conformance with the FPGs that is identified, then the specific violations are documented and shared with the responsible parties so corrective actions can be implemented (Forest Service, 2014). Notifications for corrective identify a time-period in which corrective actions must be initiative and after this time period has passed the NC Forest Service respects the site and will designate either: (1) temporary compliance – corrective actions have taken more time is needed before the full effect of those temporary actions can be felt (e.g. the time ground cover takes to re-establish); (2) permanent compliance – corrective actions are 100% in effect and working properly; (3) additional follow-up – in some instances the agency may grant the responsible party more time to fix the problem. If actions are not taken to correct sedimentation infractions the responsible parties are referred

136 <http://ncforestservice.gov/publications/Forestry%20Leaflets/WQ01.pdf>

137 North Carolina's Forestry BMPs: http://ncforestservice.gov/water_quality/bmp_manual.htm

138 Permits may be required for land clearing operations.

to the North Carolina Division of Land Resources (NCDLR) for further assessment and potential enforcement.

There are also instances where forestry operations violate other state and federal water regulation. If water quality violations other than sedimentation are identified then the party is referred to the North Carolina Division of Water Quality (NCDWQ) or the US Army Corps of Engineers, regarding pollution control and federal infractions of wetland laws (e.g. unlawful drainage of wetlands) respectively. The NCDWQ is responsible for riparian buffer rules (i.e. specific streamside management zone retention requirements) in six river basins and along trout bearing streams. Numerical buffer widths (e.g. 50 feet from the high point of the streambank) and other riparian area management specifications are not delineated in the FPGs, but are rather defined elsewhere¹³⁹ (Brogan et al. 2006). The NCDWQ also has state-level authority to regulate wetlands in instances not covered by the Clean Water Act. Isolated non-connected and “non-jurisdictional” wetlands as defined by the Corp are regulated NCDWQ but do not necessarily limit harvesting activities in these wetland areas.

In addition to BMPs the NC Forest Service and North Carolina State University have investigated developing biomass harvesting guidelines to augment their state BMPs (NC Forest Service, 2014; Fielding et al. 2012). At this point the state is not moving forward with development of separate BHGs. As for species of conservation concern, NCST§113-331.113-350 requires state listing of federal T&E species as well as other species identified at the state level. Lastly, as has been the trend in many places in the South, local governments control land use rules and sometimes these impact forestry activities (e.g. limitations on silvicultural activities). State law (NCCode.153A.452) supersedes these local laws exempting forestry operations from compliance

Table 8-21. Number and type of programs in operation at the state level in North Carolina that influence forestry practices as of 2007

| Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| 8 | 3 | 1 | 9 | 1 | 7 |
| Source: Ellefson, 2012. | | | | | |

¹³⁹ http://ncforestservice.gov/water_quality/buffer_rules.htm

Table 8-22. Percentage of time that various BMPs were implemented in North Carolina as reported by state forestry agencies.

| Year | Overall rate of BMP Implementation | Harvesting | Forest Roads | Stream Crossing | SMZs | Site Prep. | Firebreak | Chemical Application |
|------|------------------------------------|------------|--------------|-----------------|------|------------|-----------|----------------------|
| 2003 | 82% | 76% | 80% | 64% | 87% | NA | NA | 99% |
| 2008 | 85% | 85% | 86% | 72% | 91% | NA | NA | 94% |

Source: Adapted from Shepard, 2006; Southern Group of State Foresters, 2012.

South Carolina

Forest statistics

As of 2013, 68% of South Carolina is forested (13 million acres of forestland), a loss by 0.6% since 2011. The largest portion of the South Carolina forest estate is loblolly and shortleaf pine at 43% (5.6 million acres) of the total forest area, over half of which is pine plantations. Between 2011 and 2013 plantation acreage in South Carolina expanded by 1%. Upland hardwoods are the next largest category at just over 3 million acres and bottomland hardwoods are extensive too with 2 million acres.

Most forestland in South Carolina is privately owned (88%) the majority of which is NIPF land (7.6 million acres). In 2001 corporations owned just over 2 million acres and in 2011 they owned 336,000 acres which subsequently decreased to 144,000 acres in 2013 (Rose, 2015b). Between 2011 and 2013, the volume of timber harvested declined across the state by 5% but increased in two out of three regions of the state (the piedmont and southern Coastal Plain). Softwood removals dominated at 80% of the total.

Forests are maturing in South Carolina as evidenced by the share of large diameter trees across the state relative to smaller diameter classes (e.g. pulpwood). For instance between 2001 and 2013 volume of loblolly pine increased by 40% (Rose, 2015b). This general trend of increasing volume in larger diameter classes is evident in many regions of the South as pines planted in the 1990s enter the sawtimber category.

South Carolina <http://www.teaming.com/wildlife-action-plan/south-carolina>

> <http://www.forestationplans.org/states/south-carolina>

Policy framework

The South Carolina Erosion Control and Sediment Reduction Act SCECSRA (SCCode.Title.48. §14-50) is the state law driving the creation and administration of nonpoint source water quality BMPs by the South Carolina Forestry Commission. Most of the practices in the South Carolina BMPs address the protection of water quality and the requirements of the Clean Water Act related to wetlands. South Carolina BMPs are voluntary and the BMP manual notes that “BMPs are not to be construed as required under any laws pertaining to water quality on sites where there is no risk of off-site impact,” but further guidance on what constitutes a site where there is no risk of “off-site impact” is not provided in the BMP manual.

South Carolina has also developed voluntary BMPs for biomass harvesting (BHG). The South Carolina Forestry Commission developed these BMPs acknowledging that some biomass harvesting will generally be indistinguishable from other harvesting activities but that other forms of biomass harvesting (e.g. whole-tree chipping) is more intensive and has potential risks.

Risks as identified in the South Carolina BHGs include: less material/ground cover after harvest, greater exposed soil from more intense removals, risk from frequent site entry, soil compaction from more intense operations, higher levels of nutrient and carbon removals, reduced availability of coarse and fine woody debris and snags, organic material for soil input (SC Forest Service, 2012). Similar to BHGs developed for the State of Maryland, the South Carolina BHGs identify soil characteristics (texture, chemical properties, such as available water capacity) which may require retention of additional down woody material on site or avoidance of removals altogether (see map of soil suitability provided in chapter 4).

The voluntary BHGs also provide significantly greater attention to activities addressing site-level biodiversity than the state’s water quality BMPs, specifically targets for retaining at least three snags per acre where available and retaining down woody debris in a variety of size classes to equal at least 1 ton per acre (SC Forest Service, 2012).

Similar to other states, South Carolina has a law which reinforces the federal ESA. In 1974 focused on translating the federal law to be supported by state mechanism of species listing, species management, and law enforcement.

State law also requires that in order to be eligible for cost-sharing payments from state funds, landowners must submit approved forest management plans to State Forester and are required to maintain lands in a forest condition for ten years or until commercial harvest. The state offers landowners assistance through its Forest Renewal Law which establishes goals for forest regeneration. Lastly, as has been the trend in many places in the South, local governments control land use rules and sometimes these impact forestry activities (e.g. limitations on silvicultural activities). State law (SCCode.50-2-10-50) supersedes these local laws exempting forestry operations from compliance

Table 8-23. Number and type of programs in operation at the state level in South Carolina that influence forestry practices as of 2007. Source: Ellefson, 2012.

| Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| 7 | 3 | 1 | 6 | 1 | 8 |

Table 8-24. Percentage of time that various BMPs were implemented in South Carolina as reported by state forestry agencies.

| Year | Overall Rate of BMP Implementation | Harvesting | Forest Roads | Stream Crossing | SMZs | Site Prep. | Firebreak | Chemical Application |
|------|------------------------------------|------------|--------------|-----------------|------|------------|-----------|----------------------|
| 2003 | 94% | 94% | 92% | 78% | 87% | 96% | 92% | 98% |
| 2005 | 96% | 96% | 94% | 96% | 96% | NA | NA | NA |
| 2008 | 97% | 96% | 95% | 94% | 99% | NA | NA | NA |

Source: Adapted from Shepard, 2006; Southern Group of State Foresters, 2012

Georgia

Forest statistics

The state of Georgia is one of the most heavily forested states in the US. As of 2013, forestland covered 65% (24.7 million acres) of the state (Brandeis, 2015). As of 2013, 45% of Georgia’s forests were either natural pine or plantations loblolly pine or slash pine. Approximately 14% are oak-gum cypress bottomland hardwoods and 26% of Georgia’s forestland is upland hardwood.

In recent years timber stocks in Georgia have remained stable with forest growth exceeding harvests between 2009 and 2013 (Brandeis, 2015). In 2013, the volume of growth was 1.5 times greater than volume harvested, with softwood growth being 1.3 times greater and hardwood growth 1.9 times greater than harvest removals for both categories. Between 2009 and 2013 there was little change in the area of planted pine (Brandeis, 2015). A sizable class of removals has occurred as thinnings with a decline in removals happening through final clearcut harvesting in recent years.

Georgia has the highest percentage (92%) of privately owned forestland in the US. As in other southern states, Georgia has experienced significant change in the industrial forestland category with nearly complete disintegration of the forest products supply chain from the forestland base over the last decade and a half. As of 2013, TIMOs and REITs owned about 16% (4 million acres) of the forestland, while NIPF ownership has remained the largest category about 26% (6.5 million acres).

Georgia

- > <http://www.teaming.com/wildlife-action-plan/georgia>
- > <http://www.forestationplans.org/states/georgia>

Policy framework

The Georgia Forestry Commission is responsible for forestry in Georgia and mainly responsible for implementation and monitoring of the state's BMP program and overall monitoring of forest resources. State law does not require enforcement of nonpoint sources of water pollution including forestry operations but the Forestry Commission can enforce BMP infractions if they are found to occur. Georgia requires registration of professional foresters and continuing education. Forest practices (not necessarily including logging) must use a licensed professional forester. If a forester is operating without a license they are subject to penalties. Lastly, Georgia addresses T&E species at the state-level in a similar manner to the federal ESA.

Georgia law (GeorgiaCode§12.6.23) requires that wood load tickets are produced and given to landowners for each load of timber removed from their property as part of a per-unit timber sale. Load tickets are generated by the receiving mill and are required to include:

1 Ticket number,

Name and location of receiving facility,

Date received at facility,

Tract name,

County and state of origin,

Wood dealer name (if any),

Producer or logging company name,

Tree species,

Weight (tons) or scale (cords or other) information, including net weight or total scale volume,

Volume deducted as a result of defects or other classification deduction,
 Name of person receiving, weighing, or scaling wood.

Table 8-25. Number and type of programs in operation at the state level in Georgia that influence forestry practices as of 2007. Source: Ellefson, 2012.

| Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| 9 | 3 | 2 | 7 | 1 | 2 |

Table 8-26. Percentage of time that various BMPs were implemented in Georgia as reported by state forestry agencies.

| Year | Overall Rate of BMP Implementation | Harvesting | Forest Roads | Stream Crossing | SMZs | Site Prep. | Firebreak | Chemical Application |
|------|------------------------------------|------------|--------------|-----------------|------|------------|-----------|----------------------|
| 1998 | 79% | 87% | 77% | 59% | 81% | 97% | 30% | 99% |
| 2002 | 86% | 91% | 83% | 77% | 87% | 95% | 71% | 98% |
| 2004 | 90% | 94% | 89% | 81% | 91% | 99% | 85% | 100% |
| 2007 | 92% | 97% | 91% | 84% | 89% | 94% | 68% | 98% |
| 2009 | 94% | 98% | 90% | 90% | 97% | 88% | 88% | 100% |
| 2011 | 95% | 98% | 94% | 93% | 95% | 96% | 85% | 100% |

Source: Adapted from Shepard, 2006; Southern Group of State Foresters, 2012.

Florida

Forest statistics

As of 2012, Florida had 15.5 million acres of forestland. The most common forest type in Florida is the slash-longleaf pine forest-type group representing 35% (5.46 million acres) of all forest area. Most of this is slash pine plantations. Forested wetlands comprised of oak-gum-cypress cover 19%, the oak-hickory group covers 17%, the loblolly-shortleaf pine group 11%, and the oak-pine group 10% of the timberland (Brown, 2014).

| Ownership class | Acres | Percentage of total |
|------------------|--------------------|---------------------|
| Public | 4.4 million acres | 28% |
| Corporate | 6.86 million acres | 44% |
| NIPF | 4.25 million acres | 27% |

Plantations represent 32% (nearly 5 million acres) for Florida forests and softwood species comprised 57% of the volume in 2012 (Brown, 2014). Most of the hardwood volume, 43% of the total timber volume in 2012, occurred as forested wetlands. Between From 2007 to 2012 net growth of softwoods exceeded removals in all regions of the state with the state total growth-to-drain ration equaling 1.35. For hardwoods, the state-level growth-to-drain ration was positive at 2.00, while removals exceeded growth in central Florida where growth-to-drain equaled 0.88.

| | |
|---------|-----------------------------------------------------------------------------------------------------------------------|
| Florida | http://www.teaming.com/wildlife-action-plan/florida |
| | http://www.forestationplans.org/states/florida |

Policy framework

Florida water pollution control laws are administered by the Florida Department of Environmental Protection (DEP) and tiers from the federal Clean Water Act to regulate pollutants. Additional and separate state law provides water pollution prevention enforcement authority for Florida’s five water management districts. Landowners and/or loggers must file a "notice of a general permit" with a Water Management District. Florida law prohibits the state from implementing requirements beyond those of the federal Clean Water Act.

As administered by the Florida Forest Service, Florida’s water quality BMPs¹⁴⁰ are considered quasi-regulatory with the potential for enforcement. Additionally, Florida supplements its water quality BMPs with voluntary wildlife BMPs to assist

140 <http://www.freshfromflorida.com/Divisions-Offices/Florida-Forest-Service/Our-Forests/Best-Management-Practices-BMP>

landowners with complying with state T&E species laws and insulate landowners from regulations which may punish the incidental take of a state listed species. Landowners notify the Florida Forest Service and the Florida Fish and Wildlife Conservation Commission of their intent to use the wildlife BMPs, implement the wildlife BMPs, and maintain documentation that verifies they used the BMPs. If these conditions are met then the landowner is protected from an incidental take.

Florida law (FLCode.35.590.50) regulates the sale of cypress products “made from unfinished cross-sectional slabs cut from buttresses of trees of the species *Taxodium distichum*, commonly known as cypress, without first obtaining a permit from the Department of Agriculture and Consumer Services.” This law does not regulate the harvest of cypress or other forested wetland tree species and in the last decade the state of Florida has had the most extensive harvesting of cypress in the South, much of it used commercially for mulch.

Florida’s state wetland laws are some of the most extensive at in the US and are too numerous to profile here however, state laws do not allow for regulations to exceed those of the Clean Water Act. Lastly, state property rights laws¹⁴¹ can make many regulations on the books in Florida challenging to implement

Table 8-27. Number and type of programs in operation at the state level in Florida that influence forestry practices as of 2007. Source: Ellefson, 2012.

| Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| 8 | 3 | 1 | 7 | 1 | 2 |

Table 8-28. Percentage of time that various BMPs were implemented in Florida as reported by state forestry agencies.

| Year | Overall Rate of BMP Implementation | Harvesting | Forest Roads | Stream Crossing | SMZs | Site Prep. | Firebreak | Chemical Application |
|------|------------------------------------|------------|--------------|-----------------|------|------------|-----------|----------------------|
| 1997 | 96% | 98% | 91% | 93% | 99% | 97% | 97% | 100% |
| 1999 | 96% | 97% | 90% | 91% | 97% | 97% | 96% | 100% |
| 2001 | 97% | 98% | 94% | 93% | 96% | 96% | 98% | 99% |

141 http://archive.flsenate.gov/statutes/index.cfm?App_Mode=Display_Statute&URL=Ch0070/Sec001.htm&StatuteYear=2004

| | | | | | | | | |
|------|-----|-----|-----|------|-----|-----|-----|------|
| 2003 | 97% | 98% | 96% | 87% | 95% | 98% | 88% | 100% |
| 2005 | 99% | 99% | 98% | 100% | 99% | 99% | 95% | 99% |

Source: Adapted from Shepard, 2006; Southern Group of State Foresters, 2012

Alabama

Forest statistics

Timberlands are expansive in Alabama at nearly 23 million acres as of 2012. Volumes of both hardwoods (6%) and softwoods (16%) have increased since 2005. Half of the trees in Alabama are loblolly pine. Growth-to-drain of softwoods between 2005 and 2012 was 1.3. Hardwood growth has declined since 2005 in part because “much of the decline in hardwood net-growth can be attributed to the increase in area of pine plantations,” (Hartsell, 2013). Hardwood mortality in Alabama is at an all-time high and is attributed to storms along the gulf coast in 2005.

| | |
|---------|-----------------------------------------------------------------------------------------------------------------------|
| Alabama | http://www.teaming.com/wildlife-action-plan/alabama |
| | http://www.forestationplans.org/states/alabama |

Policy framework

In Alabama there are three agencies influencing forestry practices in the areas of water pollution and forest resources. The Forestry Commission has authority to promulgate rules and regulations related to water quality through the Alabama (ALCode.9.9-10A-4) and in practices this authority is exercised in the creation of the states BMPs. These practices are common standard operating procedures for harvests and forest roads. While non-regulatory there is a high reported implementation rate (97% in 2009). Alabama’s Attorney General can enforce any activity which is leading to non-compliance with water quality standards. The Alabama BMP manual does not address measures to enhance or protect wildlife habitat biodiversity. Forest productivity is minimally addressed. There are no state laws in Alabama that provide additional protections for wetlands beyond federal policies.

In addition to the federal ESA Alabama has laws which lists protected species at the state level.¹⁴² Other state laws influencing forest management in the state include a notification procedure for prescribed burning (AL CODE. Chap. 9-13-270

¹⁴²

<http://apps.americanbar.org/environ/committees/endangered/docs/AlabamaEndangeredSpeciesProtection.pdf>

through 274), a policy on insect and disease protection largely related to the Southern Pine Beetle (AL CODE. Title 9. 9-13-120 through 142) and a regulation related to the harvesting of wild ginseng (AL CODE. Chap. 9-13-240). Loggers must be licensed to operate in Alabama.

Table 8-29. Number and type of programs in operation at the state level in Alabama that influence forestry practices as of 2007. Source: Ellefson, 2012.

| Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| 7 | 3 | 1 | 7 | 1 | 3 |

Table 8-30. Percentage of time that various BMPs were implemented in Alabama as reported by state forestry agencies.

| Year | Overall Rate of BMP Implementation | Harvesting | Forest Roads | Stream Crossing | SMZs | Site Prep. | Firebreak | Chemical Application |
|------|------------------------------------|------------|--------------|-----------------|------|------------|-----------|----------------------|
| 2009 | 97% | 96% | 93% | 96% | 92% | 98% | 90% | 100% |
| 2010 | 97% | 98% | 93% | 96% | 97% | 98% | 97% | 98% |

Source: Adapted from Shepard, 2006; Southern Group of State Foresters, 2012.

Mississippi

Forest statistics

Forestland covers 65% (19.6 million acres) of Mississippi. As of 2006, 72% of Mississippi's forestland was naturally regenerated and 36% was loblolly pine, 27% was upland oak-hickory, and 19% was bottomland hardwoods. As of 2006 most (78%) of timberland in the state was owned by NIPF owners and 10% was owned by corporations. Between 1994 and 2006 softwood growth exceeded removals by 29% and hardwood growth exceeded removals by 22%. Between 1994 and 2006 plantations increased slightly at the expense of naturally regenerated stands.

| | |
|-------------|-------------------------------------------------------------------------------------------------------------------------------|
| Mississippi | http://www.teaming.com/wildlife-action-plan/mississippi |
| | http://www.forestationplans.org/states/mississippi |

Policy framework

The Mississippi Forestry Commission is the main body responsible for implementing forest related laws in the state. State law prohibits regulations at the state-level that are more restrictive than the federal Clean Water Act and state BMPs¹⁴³ are voluntary with the potential for enforcement and there is generally not a permit, inspection, or notification process.

Mississippi forest law has a variety of requirements in state law¹⁴⁴ for leaving residual trees when harvesting for growing stock and/or seed trees after harvest. The Mississippi forestry commission can enforce these regeneration laws by injunction and a civil penalty may apply. However, there generally is not an inspection or permit process for timber harvesting in Mississippi to determine that these rules are being followed.

Like most other states, Mississippi passed a T&E species law shortly after passage of the federal ESA to clarify the role of the state in implementing the federal law. Mississippi's law also has a state-level species listing and protections regulatory process.

Table 8-31. Number and type of programs in operation at the state level in Mississippi that influence forestry practices as of 2007. Source: Ellefson, 2012.

| Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| 7 | 2 | 1 | 6 | 2 | 6 |

Table 8-32. Percentage of time that various BMPs were implemented in Mississippi as reported by state forestry agencies

| Year | Overall Rate of BMP Implementation | Harvesting | Forest Roads | Stream Crossing | SMZs | Site Prep. | Firebreak | Chemical Application |
|------|------------------------------------|------------|--------------|-----------------|------|------------|-----------|----------------------|
| 2003 | 89% | 93% | 95% | 89% | 89% | 90% | 81% | 95% |
| 2007 | 93% | 95% | 96% | 91% | 93% | 91% | 92% | 96% |
| 2010 | 93% | 95% | 91% | 92% | 94% | 96% | 92% | 98% |

143 http://www.mfc.ms.gov/pdf/Mgt/WQ/Entire_bmp_2008-7-24.pdf

144 Forest Harvesting. MS CODE. Title 49. Chap. 19. Sec. 53.; Leave Trees Involving Harvest of Naval Stores. MS CODE. Title 49. Chap. 19. Sec. 55.; Pine Tree Stocking After Harvest. MS CODE. Title 49. Chap. 19. Sec. 57.; Hardwood Tree Stocking After Harvest. MS CODE. Title 49. Chap. 19. Sec. 59.; Seed Tree Requirements after Harvest. MS CODE. Title 49. Chap. 19. Sec. 61.

Source: Adapted from Shepard, 2006; Southern Group of State Foresters, 2012.

Tennessee

Forest statistics

As of 2012, there were 13.5 million acres of timberland in Tennessee, 84% of which was privately owned (Oswalt and King, 2014). Upland hardwoods dominate with 72% being in the oak hickory group only 7% is planted as loblolly. Between 2011 and 2012, average annual net growth has declined while mortality and removals increased yet growth-to-drain ratios remained positive for both softwoods and hardwoods.

| | |
|-----------|---------------------------------------------------------------------------------------------------------------------------|
| Tennessee | http://www.teaming.com/wildlife-action-plan/tennessee |
| | http://www.forestationplans.org/states/tennessee |

Policy framework

There are several state agencies involved in forestry issues in Tennessee mostly focused on implementation of water quality laws. The Tennessee Division of Forestry is charged with the state's water quality BMP¹⁴⁵ program and forestry issues more generally. Tennessee's BMPs are voluntary with potential enforcement. There is no notification, permit, or inspection procedure however the Division of Forestry can issue a stop work order if it is discovered that silvicultural activities are having an adverse effect on water quality.

Like most other states, Tennessee passed a T&E species law (T.C.A. §70-8-101 to 112) shortly after passage of the federal ESA to clarify the role of the state in implementing the federal law. Mississippi's law also has a state-level species listing and protections regulatory process. Likewise, Tennessee has state-level laws for water quality meant to enforce provisions of the federal Clean Water Act, especially those related to point sources.

Table 8-33. Number and type of programs in operation at the state level in Tennessee that influence forestry practices as of 2007. Source: Ellefson, 2012.

| Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| 9 | 3 | 1 | 9 | 1 | 5 |

¹⁴⁵ <http://www.tn.gov/agriculture/forestry/bmps.shtml>

Table 8-34. Percentage of time that various BMPs were implemented in Tennessee as reported by state forestry agencies.

| Year | Overall Rate of BMP Implementation | Harvesting | Forest Roads | Stream Crossing | SMZs | Site Prep. | Firebreak | Chemical Application |
|------|------------------------------------|------------|--------------|-----------------|------|------------|-----------|----------------------|
| 2007 | 89% | 93% | 91% | 80% | 85% | 90% | NA | NA |

Source: Adapted from Shepard, 2006; Southern Group of State Foresters, 2012.

Kentucky

Forest statistics

Twelve million acres, 47 percent of Kentucky’s 25,425,904 acres, are covered in forest. NIPF owners possess 78% timberland, while corporations own 13%, and the remainder is publicly owned. More than 95% of the sawtimber harvested annually comes from NIPF owners and they collectively receive an estimated \$153 million for their harvests. As of 2011, Kentucky’s forests had increased the total growing stock by approximately 1-2% annually since the late 1980s (Oswalt, 2011).

| | |
|----------|-------------------------------------------------------------------------------------------------------------------------|
| Kentucky | http://www.teaming.com/wildlife-action-plan/kentucky |
| | http://www.forestationplans.org/states/kentucky |

Policy framework

Kentucky law specifies that most aspects of state pollution control laws be no more stringent than the federal Clean Water Act. Kentucky has enforceable water pollution control laws that extend to forestry and other nonpoint pollution sources. Penalties for a knowing violation include significant fines and possible imprisonment. The Kentucky State Forest Conservation Act¹⁴⁶ establishes enforceable mechanisms applicable to commercial timber harvesting regulations requiring the use of a certified "master logger" completed a three-day course on appropriate harvesting technique and compliance with state water quality BMPs.¹⁴⁷ Continuing education is also required for loggers to maintain the master logger certification. Kentucky’s BHGs¹⁴⁸ may also be presented during training and continuing education and remain voluntary. At present there are 2,990 Kentucky

¹⁴⁶ <http://www.lrc.ky.gov/Statutes/chapter.aspx?id=37723>

¹⁴⁷ http://www2.ca.uky.edu/forestryextension/publications/for_forfs/for67.pdf

¹⁴⁸ <http://forestry.ky.gov/Documents/Biomass%20Harvsting%20Recommendations%20Oct%202011.pdf>

Master Loggers¹⁴⁹ registered with the state including several in Tennessee and Virginia.

If a logger or operator fails to use appropriate BMPs or is found to be causing water pollution, a written warning is issued and/or the logger meets with a forester employed by the state to implement remedial actions. Continued failure to comply can result in enforcement action and listing as a "bad actor" on a publicly disclosed list. There are 197 logging companies listed on this list as of May 2015.

Table 8-35. Number and type of programs in operation at the state level in Kentucky that influence forestry practices as of 2007. Source: Ellefson, 2012.

| Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| 7 | 2 | 1 | 6 | 1 | 8 |

Louisiana

Forest statistics

Louisiana's forests cover 48% of the state's area (15 million acres). NIPF owners control 62% of the state's forestland. Corporate investment own 29%, and the public owns 9%. Loblolly pine represents 61% of all trees in Louisiana, oak-gum-cypress bottomlands make up 3.7 million acres, and upland hardwoods comprise 3.5 million acres. Most forests (61%) are naturally regenerated, although 39% of trees are planted.

A full 60% of the total tree volume in Louisiana is estimated to be hardwood with 56% of hardwood volume to be bottomland hardwoods. In 2012 the growth-to-drain ration for all forestland was calculated to be positive at 1.3. Removals are about 3% of the total standing volume each year and the vast majority is plantation pine.

| | |
|-----------|---------------------------------------------------------------------------------------------------------------------------|
| Louisiana | http://www.teaming.com/wildlife-action-plan/louisiana |
| | http://www.forestationplans.org/states/louisiana |

Policy framework

In Louisiana the Department of Agriculture and Forestry administers the state's voluntary BMPs¹⁵⁰ which are voluntary with the potential for enforcement. There is no notification, permit, or inspection procedure. Louisiana passed a T&E species

¹⁴⁹ A list of certified Kentucky Master Loggers is available here:

http://dept.ca.uky.edu/masterlogger/search_adv.asp

¹⁵⁰ <http://www.ldaf.state.la.us/forestry/management/best-management-practices-and-statistics/>

law after passage of the federal ESA to clarify the role of the state in implementing the federal law. Louisiana’s law also has a state-level species listing and protections regulatory process. Likewise, state-level laws for water quality meant to enforce provisions of the federal Clean Water Act, especially those related to point sources. Louisiana’s Natural and Scenic Rivers Act prohibits commercial timber harvesting within 100 feet of low water marks.

Table 8-36. Number and type of programs in operation at the state level in Louisiana that influence forestry practices as of 2007. Source: Ellefson, 2012.

| Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| 6 | 3 | 1 | 8 | 1 | 3 |

Arkansas

Forest statistics

About 55% of Arkansas (18.4 million acres) is forestland. Upland hardwoods (oak-hickory) comprise about 42% of all woodland, followed by loblolly/shortleaf pine at 29%. NIPF owners own nearly 60% and corporate investors own or lease 23%.

| | |
|----------|-------------------------------------------------------------------------------------------------------------------------|
| Arkansas | http://www.teaming.com/wildlife-action-plan/arkansas |
| | http://www.forestationplans.org/states/arkansas |

Policy framework

In Arkansas nine agencies influence forestry as authorized by pollution control and other state laws. The Arkansas Pollution Control and Ecology Commission is authorized (Ark. Code Ann. § 8-1-203(b)) to establish regulations related to controlling water pollution. The Commission is required to evaluate the economic impact of laws that would be more stringent than the Clean Water Act. State water laws do not contain enforcement requirements for nonpoint source water pollution and forestry. State law regulating certain riparian buffer requirements (AR Stat.41.17.116) require certain minimum buffer widths on certain water bodies. AR Stat.5.6.72.102 places minimal restrictions on riparian and wetland harvesting specifying that “it is unlawful to remove any trees growing below the normal high watermark on any river or stream which has been designated as a navigable river or stream,” and making violators are subject to a fine of \$100 - \$1,000. Arkansas landowners are required to notify the state of their intent to perform a controlled burn (AR Stat.20.22.302). Under Amendment 35¹⁵¹ to the Constitution of the State

¹⁵¹ http://www.agfc.com/enforcement/Documents/agfc_code_of_regulations.pdf

of Arkansas the Arkansas Fish and Game Commission is given the authority to regulate T&E species listed at the state-level.

Table 8-37. Number and type of programs in operation at the state level in Arkansas that influence forestry practices as of 2007. Source: Ellefson, 2012.

| | Education and extension programs | Technical assistance programs | Tax incentive programs | Financial assistance programs | Land trust and easement programs | Regulatory programs |
|----------|----------------------------------|-------------------------------|------------------------|-------------------------------|----------------------------------|---------------------|
| Arkansas | 7 | 3 | 2 | 8 | 1 | 2 |

Table 8-38. Percentage of time that various BMPs were implemented in Arkansas as reported by state forestry agencies.

| Year | Overall Rate of BMP Implementation | Harvesting | Forest Roads | Stream Crossing | SMZs | Site Prep. | Firebreak | Chemical Application |
|------|------------------------------------|------------|--------------|-----------------|------|------------|-----------|----------------------|
| 2003 | 88% | 97% | 81% | 89% | 86% | 85% | 52% | 83% |
| 2006 | 88% | 96% | 85% | 90% | 81% | 86% | 55% | 87% |
| 2008 | 86% | 94% | 74% | 86% | 83% | 81% | 72% | 96% |
| 2011 | 89% | 97% | 85% | 84% | 86% | 74% | 80% | 100% |

Source: Adapted from Shepard, 2006; Southern Group of State Foresters, 2012.

Texas

Forest statistics

Long-term trends for East Texas point to stable forestland area and growing tree volumes (Dooley & Brandeis, 2014). Hardwood forest types make up the majority of timberland area in East Texas, accounting for 6.4 million acres, compared to 5.4 million acres for softwood.

Softwood timberland is split nearly equally between naturally regenerated and planted stands. Together natural and planted loblolly comprise the largest volume of trees in East Texas. Oak-hickory is the predominant hardwood with 2.8 million acres, followed by oak-pine (1.4 million acres), and bottomland hardwoods (oak-gum-cypress) at 1.3 million acres (Dooley & Brandeis, 2014). NIPF owners control 55% of East Texas' timberland. Vertically integrated forest industry-held land has decreased by 92% since 2004, making up just over 2% in 2013, while over the same period, other corporate owners, including TIMOs and REITs increased their share of timberland by 257% to hold 34% of East Texas' timberland.

Average annual net growth for all-live softwood species decreased by 12% from 2009 - 2013. Softwood removals declined by about 24% from 2009 - 2013, while average annual softwood mortality increased by nearly 50%. Average annual net growth for hardwoods decreased by 73% from 2009 – 2013 and average annual removals of hardwood also decreased by 27% over this same time period.

| | |
|-------|-------------------------------------------------------------------------------------------------------------------|
| Texas | http://www.teaming.com/wildlife-action-plan/texas |
| | http://www.forestationplans.org/states/texas |

Policy framework

The Texas Soil and Water Conservation Board and soil and water conservation districts are authorized to management programs to control silvicultural nonpoint source pollution. Where silvicultural nonpoint sources are identified as important water quality problems the Board can develop a plan for addressing the problem and implement aspects of the plan using local soil and water conservation districts. This is done for places where water quality standards are not being met. The Texas Forest Service administers the state’s voluntary BMP¹⁵² program which is voluntary with possible enforcement.

Texas passed a T&E species law after passage of the federal ESA to clarify the role of the state in implementing the federal law. Texas law also affords the state the ability to list state-level species and provide protections. Likewise, state-level laws for water quality meant to enforce provisions of the federal Clean Water Act.

Table 8-39. Percentage of time that various BMPs were implemented in Texas as reported by state forestry agencies

| Year | Overall Rate of BMP Implementation | Harvesting | Forest Roads | Stream Crossing | SMZs | Site Prep. | Firebreak | Chemical Application |
|------|------------------------------------|------------|--------------|-----------------|------|------------|-----------|----------------------|
| 2000 | 89% | 98% | 84% | 67% | 86% | 96% | 96% | 100% |
| 2002 | 92% | 97% | 90% | 85% | 88% | 90% | 88% | 95% |
| 2005 | 92% | 97% | 92% | 81% | 91% | 95% | 96% | 100% |
| 2008 | 92% | 98% | 92% | 82% | 88% | 98% | 100% | 100% |
| 2011 | 94% | 99% | 96% | 85% | 90% | 98% | 89% | 98% |

Source: Adapted from Shepard, 2006; Southern Group of State Foresters, 2012.

¹⁵² <http://texasforests.tamu.edu/BestManagementPractices/>

Appendix C Comparison of southern state BMP and BHG programs to criteria and indicators for sustainable forestry

A = Applicable, P = partially applicable, N = Not applicable

| Adapted Montreal Process Criteria | | BMP Programs | | | | | | | | | | | BHG | | |
|-----------------------------------|-----------------------------------------------------------------------------------------|--------------|----|----|----|--------|--------|----|--------|--------|--------|--------|-----------|-----------|-----------------|
| | | TX | LA | MS | AL | T N | K Y | VA | N C | S C | G A | F L | KY BHG | SC BHG | Forest Guild |
| 1 | Conservation of Biological Diversity | | | | | | | | | | | | | | |
| 1.1 | Species Diversity | N | N | N | N | N | N | N | N | P | N | N | N | P | P |
| 1.1.1 | Important Species (i.e. state natural heritage) identified in a forest management plan. | N | N | N | N | N | N | P | N | P | N | N | P | A | A |
| 1.2 | Provisions for Genetic Diversity | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 1.3 | Important Wildlife Habitat Across Landscape | N | N | N | N | N | N | N | N | P | N | N | N | P | P |
| 1.4 | Important Wildlife Habitat at the Stand Level | N | N | N | N | N | N | N | N | P | N | P | A | A | A |
| 1.5 | Amount and distribution of organic matter present on forest floor. | N | N | N | N | N | N | P | N | N | N | N | A | A | A |
| 1.6 | Ecological Reserves/Special Area/Protected Areas | N | N | N | N | N | N | P | N | N | N | P | P | P | P |
| 1.7 | Rare forest types (e.g. old growth) | N | N | N | N | N | N | N | N | N | N | N | P | P | A |
| 1.8 | Riparian & Aquatic System Biological Resources | N | N | N | P | N | P | P | N | N | N | N | N | P | P |
| 2 | Maintenance of Productive Capacity of Forest Ecosystems | | | | | | | | | | | | | | |
| 2.1 | Ecological Function/Maintenance of Forest Nutrient Capital over the Long-term | N | N | N | N | N | N | N | N | N | N | N | P | P | P |

| | | | | | | | | | | | | | | | |
|-------|---------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.2 | Landscape-Scale Spatial Patterns (e.g. fragmentation & connectivity) | N | N | N | N | N | N | N | N | N | N | N | N | N | P |
| 2.3 | Representation of Regionally-Appropriate Forests and Structural Diversity | N | N | N | N | N | N | N | N | N | N | N | N | P | A |
| 2.4 | Retention of deadwood (Coarse Woody Debris, Fine Woody Debris, Snags) | N | N | N | P | N | P | P | N | N | N | N | A | A | A |
| 3 | Maintenance of forest ecosystem health and vitality | | | | | | | | | | | | | | |
| 3.1 | Forest Protection/Health: Fire | P | P | P | P | P | P | P | P | P | P | P | N | P | P |
| 3.2 | Forest Protection/Health: Exotic Species/ Noxious Weeds | N | N | N | N | N | N | N | N | N | N | N | N | N | P |
| 3.3 | Forest Protection/Health: Pests & Pathogens | N | N | N | N | N | N | P | N | N | N | N | N | N | P |
| 3.4 | Forest Protection/Health: Hazardous Materials/Debris/Waste | A | A | A | A | A | A | A | A | A | A | A | N | N | N |
| 3.5 | Harvest Operations & Access: Forest Roads | A | A | A | A | A | A | A | A | A | A | A | N | N | N |
| 3.5 | Vehicles and machinery used in harvest should cause minimal damage to ecosystem | P | N | N | P | N | N | P | N | N | N | N | N | N | A |
| 4 | Conservation and maintenance of soil and water resources | | | | | | | | | | | | | | |
| 4.1 | Resource Conservation: Water Yield and Water Quality | A | A | A | A | A | A | A | A | A | A | A | P | P | P |
| 4.2 | Resource Conservation: Soil Nutrient Status/Erosion | P | P | P | P | P | P | P | P | P | P | P | P | P | P |
| 4.2.1 | Resource Conservation: Soil Erosion | A | A | A | A | A | A | A | A | A | A | A | A | P | P |

| | | | | | | | | | | | | | | | |
|-----------|------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.3 | Practices in place to protect chemical, biological, and physical properties of soils | P | P | P | P | P | P | P | P | P | P | P | P | P | P |
| 4.4 | Best Management Practices | A | A | A | A | A | A | A | A | A | A | A | P | P | P |
| 4.5 | Minimize biomass harvest in nutrient poor, shallow , or steep sloped soils | N | N | N | N | N | N | N | N | N | N | N | P | A | P |
| 5 | Maintenance of forest contribution to global carbon cycles | | | | | | | | | | | | | | |
| 5.2 | Management of biogenic carbon flows in forest ecosystems so that GHG reduction benefits are realized through carbon storage. | N | N | N | N | N | N | N | N | N | N | N | N | N | P |
| 7 | Legal, institutional and economic framework for forest conservation and sustainable management | | | | | | | | | | | | | | |
| 7.1.9 | Forest Practices Regulations & Guidelines: Compliance Provisions | N | N | N | N | N | P | P | N | N | N | N | N | N | N |
| 7.2.6 | Forest Planning: Management Plan | N | N | A | N | N | N | P | N | P | N | N | P | P | P |
| 7.2.7 | Forest Planning: Mapping | A | A | A | A | A | A | A | A | A | A | A | N | P | A |
| 7.2.8 | Forest Planning: Timber Inventory | N | N | P | N | N | N | P | N | N | N | N | N | N | N |
| 7.2.9 | Forest Planning: Sustained Yield | N | N | P | N | N | N | N | N | N | N | N | N | N | N |
| 7.2.1 1 | Silviculture: Reforestation--Regeneration | P | P | P | P | P | P | P | P | P | P | P | P | N | N |
| 7.2.1 2.1 | Silviculture: Clearcutting | N | N | N | N | N | N | P | N | N | N | P | N | N | N |
| 7.2.1 3 | Silviculture: Retention & Residual Trees/Stand | P | P | P | P | P | N | P | N | N | N | N | A | P | A |
| 7.2.1 4 | Silviculture: Reforestation--Site Preparation | A | A | A | A | A | A | A | A | A | A | A | P | N | N |
| 7.2.1 8 | Silviculture: Stand Management--Application of | A | A | A | A | A | A | A | A | A | A | A | N | N | N |

| | | | | | | | | | | | | | | | |
|------------|-----------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pesticides | | | | | | | | | | | | | | |
| 7.2.1 9 | Silviculture: Stand Management-- Prescribed Fire | A | A | A | A | A | A | A | A | A | A | A | N | N | N |
| 7.2.2 0 | Special Treatments: Salvage Harvests | N | N | N | N | N | N | P | N | N | N | N | N | N | A |

Appendix D Summary table of key issues influencing estimates of net C emissions effects of wood energy use and suggested choices in C accounting of wood energy system

| Key issue | Description | Application/suggested use |
|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Type of LCA</i> | | |
| Attributional life cycle analysis (ALCA) | <p>Considers a sustainably grown biomass that is used for energy to be C neutral. Does not identify the amount of avoided emissions that may occur due to substitution of biomass energy for fossil fuel energy outside a product's life cycle.</p> <p>Does not consider the timing of emissions and removals.</p> | <p>The choice of LCA will depend on the particular event being examined and the specific questions being addressed. For example, if we are interested in understanding the level of emissions associated with a particular activity, then an ALCA may be applied. Conversely, if we are interested in changes in emissions over time, a CLCA may be applied.</p> |
| Consequential life cycle analysis (CLCA) | <p>Allows for comprehensive examination of wood energy systems in the context of the biophysical and economic interactions including emissions at the time of conversion and follow-on changes in C stock on the land due to direct as well as market induced (indirect) land use and management change.</p> <p>Extra uncertainties may arise.</p> | |
| <i>System Boundary</i> | | |
| Stand level | Incomplete perspective | Less likely |
| Landscape level | Broader perspective | More likely |
| National level | Broader perspective | More likely |
| <i>Baseline</i> | | |
| Reference point | Net GHG in the atmosphere during and at the end of an assessment period is compared with GHG in the atmosphere at the beginning | The choice of baseline will depend on the constraints and objectives of the policy context for the C accounting. |
| Business-as-usual (BAU) | Emissions from proposed bioenergy system is compared with emissions from expected future scenario of wood energy consumption, does not consider fossil fuel displaced. | |
| Comparative | Net emissions from bioenergy system being evaluated are compared with emissions from an alternate fossil fuel | |

| | | |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | system. | |
| <i>Timing of emissions and sinks</i> | | |
| Period of operation of bioenergy system | e.g., 1 year, 30 years | Depending on the metric used to estimate GHG impact this period could extend from each year's wood burning emissions or it could extend to 100 years after the start of the bioenergy system |
| Period over which to track C change on the land | e.g., 100 years | |
| C neutrality factor | Identifies whether the cumulative emissions from the bioenergy system are higher than, lower than, or equal to those from reference system. | Less likely to be used as it does not directly characterize the impact on climate in terms of radiative forcing during the period of C debt and thereafter. |
| C payback time | Refers to the time required to fully offset initial bioenergy emissions by biomass regrowth or other land C change (time needed to make zero C debt). | Same as above |
| Global warming potential (GWP) based on cumulative radiative forcing (CRF) | The time-integrated global mean radiative forcing of a pulse emission of a given gas, over some given time period stated in tonnes of CO ₂ that would produce the same cumulative radiative forcing. | More likely to be used because GWP based on CRF over 100 years has the benefit that it is the same metric used to gauge the impact of each type of GHG by IPCC. |
| <i>Land use change (LUC)</i> | | |
| Direct LUC | Caused by a direct conversion of existing land use to a new land use to supply biomass feedstock. | Need to consider the net emission effect of LUC due to wood energy. |
| Indirect LUC | Caused by promise of future revenue for biomass. Leakage occurs when iLUC result in greater emissions. Spillage occurs when iLUC result in more C storage. | |
| Uncertainty | Uncertainties can occur at several stages in the accounting process due to uncertainty in modelling assumptions and input parameters. | Need to evaluate the effect of uncertainties on estimated net C emissions of wood energy use through Monte Carlo simulation or sensitivity analysis. |

Appendix E Policy screening

| | Policy name and description | Source | External constraints | Within scope of study? | Number and type of risks addressed | Existing MS or industry initiative? | Mitigation hierarchy |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------------------------------------|------------------------|---------------------------------------------------------------|-------------------------------------|----------------------|
| | <i>Criteria for exclusion II Policy name and description</i> | | Yes | No | None | No | Lowest |
| 1 | Extend the sustainability criteria for biofuels to other uses of the same crops (food, feed, products, materials) | Vito (2013) | Depends on design, but unlikely | No | | | |
| 2 | Include "indirect land use" (ILUC) in sustainability criteria for biofuels | Vito (2013) | No | Yes | Primarily addresses risk 2 (forest) and risk 4 (carbon stock) | No | |
| 3 | Sustainability criteria for solid and gaseous biomass | Vito (2013) | Depends on design, but unlikely | Yes | Primarily addresses risk 2 (forest) and risk 4 (carbon stock) | | |
| 4 | Promote Reducing Emissions from Deforestation and forest Degradation (REDD+) | Vito (2013) | | | | | |
| 5 | Encourage protein crop production in the European Union | Vito (2013) | Depends on how this is structured | No | | | |
| 6 | Include mandatory crop rotation, including minimum levels of legume/protein crops, in the CAP cross-compliance rules | Vito (2013) | Depends on how this is structured | No | | | |
| 7 | Promote sustainable intensification of agricultural and forest production in areas where current production is well below the agronomic and silvicultural production potential | Vito (2013) | Depends on how this is structured, but likely | No | | | |
| 8 | Promote relevant concepts and measures for 'climate smart agriculture' | Vito (2013) | No | No | | | |
| 9 | Promote and strengthen FLEGT, and expand to other commodities | Vito (2013) | No | Yes | Primarily risk 1 (biodiversity) and risk 2 (forest loss) | No | |
| 10 | Raise awareness of the linkages between EU | Vito | No | No | | | |

| | Policy name and description | Source | External constraints | Within scope of study? | Number and type of risks addressed | Existing MS or industry initiative? | Mitigation hierarchy |
|----|----------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------------------|------------------------|------------------------------------|-------------------------------------|----------------------|
| | <i>Criteria for exclusion II</i> Policy name and description | | Yes | No | None | No | Lowest |
| | consumption and deforestation | (2013) | | | | | |
| 11 | Targeted awareness raising and information campaigns on food waste production | Vito (2013) | No | No | | | |
| 12 | Develop mandatory Member State specific food waste prevention targets | Vito (2013) | No | No | | | |
| 13 | Increase the clarity and consistency in the use of food date labels | Vito (2013) | No | No | | | |
| 14 | Develop mandatory and consistent food storage labels on food products | Vito (2013) | No | No | | | |
| 15 | Promote healthier and diverse food consumption with less emphasis on meat products | Vito (2013) | No | No | | | |
| 16 | Consumer tax on meat products | Vito (2013) | Depends on design, but likely | No | | | |
| 17 | Mandatory labelling of the origin of food products, main ingredients and ingredients that are associated with deforestation | Vito (2013) | Depends on design | No | | | |
| 18 | Mandatory labelling of the forest footprint of (food) products | Vito (2013) | Depends on design | Partly | Mainly risk 4 (carbon stock) | Unknown, but unlikely | Lowest |
| 19 | General requirement to apply stringent public procurement principles with respect to the deforestation impact of products and services | Vito (2013) | Depends on design | | | | |
| 20 | Review the current rules and regulations for use of animal byproducts | Vito (2013) | No | No | | | |
| 21 | Strengthen voluntary initiatives certifying sustainably produced (deforestation-free) commodities | Vito (2013) | No | Yes | Depends on design | Yes | Depends on design. |
| 22 | Strengthen the environmental provisions in trade agreements | Vito (2013) | Depends on design | No | | | |
| 23 | Increase the import tariffs of commodities that are associated with deforestation | Vito (2013) | Depends on design, but likely | No | | | |
| 24 | Attach sustainability criteria to the import of commodities that are associated with deforestation | Vito (2013) | Depends on design, | No | | | |

| | Policy name and description | Source | External constraints | Within scope of study? | Number and type of risks addressed | Existing MS or industry initiative? | Mitigation hierarchy |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------------------|------------------------|----------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------|
| | <i>Criteria for exclusion II</i> Policy name and description | | Yes | No | None | No | Lowest |
| | | | but likely | | | | |
| 25 | Investment tax (for portfolio investors investing in corporations with a 'positive' forest footprint) | Vito (2013) | Depends on design, but likely | No | | | |
| 26 | Make the protection of foreign direct investments under Bilateral Investment Treaties (BITs) conditional upon specific deforestation related responsible investment criteria | Vito (2013) | Depends on design | No | | | |
| 27 | Make the protection of foreign direct investments by export credits dependent on specific deforestation related responsible investment criteria | Vito (2013) | Depends on design | No | | | |
| 28 | Assist in the development of a responsible investment framework | Vito (2013) | Depends on design | No | | | |
| 29 | Promote guidelines for Responsible Agricultural Investments (RAI) including criteria for safeguarding environmental and social sustainability, building on a World Bank led initiative (see https://www.responsibleagroinvestment.org/rai/) | Vito (2013) | Depends on design | No | | | |
| 30 | Facilitate and support the mandatory integration of environmental issues (among which deforestation) into development actions | Vito (2013) | Depends on design | No | | | |
| 31 | Raise awareness and develop the capacities of the staff working on the integration of environmental issues in development cooperation | Vito (2013) | No | No | | | |
| 32 | Research to obtain a monitoring tool on the impact of EU consumption on worldwide deforestation | Vito (2013) | No | Depends on design | Depends on design, but likely to target risk 2 (forest loss) and risk 4 (carbon stock) | Potentially, yes | Does not mitigate, but only monitor |
| 33 | Research on technologies and policies to reduce the impact of EU consumption on deforestation in third countries | Vito (2013) | No | No | | | |
| 34 | Promote activities, which actively seek for synergies between the CAP and policies aiming at reducing deforestation (REDD+; | Vito (2013) | No | No | | | |

| | Policy name and description | Source | External constraints | Within scope of study? | Number and type of risks addressed | Existing MS or industry initiative? | Mitigation hierarchy |
|----|-----------------------------------------------------------------------------------------|----------------------|-------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------|
| | <i>Criteria for exclusion II</i> <i>Policy name and description</i> | | Yes | No | None | No | Lowest |
| | biodiversity strategy) | | | | | | |
| 35 | Public procurement policies requiring legal and sustainable products | Chatham House (2013) | Depends on design | No | | | |
| 36 | Government standards or criteria | Chatham House (2013) | Depends on design | Yes | Depends on design | Yes | Depends on design |
| 37 | Licensing systems in bilateral agreements | Chatham House (2013) | | | | | |
| 38 | Broader legislative controls (make illegal imported products illegal in import country) | Chatham House (2013) | No | No | | | |
| 39 | 'Due diligence' requirements on industry | Chatham House (2013) | No | Yes | Depends on design, but likely to target either risk 1 (biodiversity), risk 2 (forest loss) and risk 4 (carbon stock) | Yes | Depends on design |
| 40 | Systems (new or existing) to differentiate between products e.g. certification | Chatham House (2013) | Depends on system design | Yes | Depends on design, but likely to target either risk 1 (biodiversity), risk 2 (forest loss) and risk 4 (carbon stock) | Yes | Depends on design |
| 41 | Chain-of-custody tracking | Chatham House (2013) | Depends on system design | Yes | Depends on design, but likely to target either risk 1 (biodiversity), risk 2 (forest loss) and risk 4 (carbon stock) | Yes | Depends on design |
| 42 | Tariffs | Chatham House (2013) | Yes | | | | |
| 43 | Subsidies | Chatham House (2013) | Depends on design, but likely | No | | | |

| | Policy name and description | Source | External constraints | Within scope of study? | Number and type of risks addressed | Existing MS or industry initiative? | Mitigation hierarchy |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------|------------------------|----------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------|
| | <i>Criteria for exclusion II</i> Policy name and description | | Yes | No | None | No | Lowest |
| 44 | Labelling | Chatham House (2013) | No | Yes | Depends on design, but likely to target either risk 1 (biodiversity), risk 2 (forest loss) and risk 4 (carbon stock) | Yes | Depends on design |
| 45 | Free trade agreements (?) | Chatham House (2013) | No | No | | | |
| 46 | Reporting requirements | Chatham House (2013) | No | Yes | Depends on design | Yes | Depends on design |
| 47 | 'Due diligence' for financial institutions and investments by public agencies | Chatham House (2013) | Depends on design | No | | | |
| 48 | Anti-money-laundering legislation | Chatham House (2013) | No | No | | | |
| 49 | Public-private partnerships | Chatham House (2013) | No | Depends on design | | | |
| 50 | Commitments by proponents of significant new forest bioenergy projects in the EU to demonstrate genuine and significant GHG emissions reductions. Would require strategic assessment of the total GHG emissions impacts of commercial decisions involving major changes in activities that will lead to increased consumption of forest bioenergy. | Matthews et al. (2015) | No | Yes | Likely to target risk 4 (carbon stock) only | No | |
| 51 | Decision-tree approach for initial screening of sources of bioenergy | Matthews et al. (2015) | No | Yes | Depends on design, but could potentially target all four risks. | Unknown | Depends on design |
| 52 | Co-production of forest bioenergy with additional material wood products, targeting the displacement of GHG-intensive counterfactual products, and encouraging the disposal of wood products at end of life with low impacts on GHG emissions. | Matthews et al. (2015) | No | Depends on design | Most likely to target risk 3 (Reduced Resource Efficiency and Circularity) | Unknown | Depends on design |
| 53 | Encouraging the management of vegetation carbon balances as part of initiatives aimed at | Matthews et al. | No | Yes | Most likely to target risk 4 | | |

| | Policy name and description | Source | External constraints | Within scope of study? | Number and type of risks addressed | Existing MS or industry initiative? | Mitigation hierarchy |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------|------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------|---------------------------------------|
| | <i>Criteria for exclusion II</i> <i>Policy name and description</i> | | Yes | No | None | No | Lowest |
| | increasing the supply/consumption of bioenergy | (2015) | | | (carbon stock) only | | |
| 54 | Increase the use of forest residues: › Remove legal restrictions to removing extra forest biomass (provided it does not release of soil carbon). | | No | Yes | Most likely to target risk 4 (carbon stock) only | No | |
| 55 | › Legal obligations to collect forest residues from clear cutting areas (when sustainable and prevent or reduce the intensity of forest fires). | | No | Yes | Most likely to target risk 4 (carbon stock) only | No | |
| 56 | › National and EU support measures to decrease the negative impact of the increased costs of biomass, e.g. redirection of energy subsidies to wood mobilisation. | | Depends on design | Yes | Most likely to target risk 4 (carbon stock) only | No | |
| 57 | › Measures targeted to the forest owners and/or harvesters as support for delivering wood. | | No | Yes | Depends on design, but could target risk 1, 2 and 4. | Yes | Depends on design, but similar to NCA |
| 58 | › Statistics, terminology and data on forest residues harmonised within the EU. | | No | No | | | |
| 59 | Prioritise the end uses of wood, by matching the technical suitability of the various categories available with end-user requirements | | No | Depends on design, but could be included | Depends on design, but most likely to target risk 3 (Reduced Resource Efficiency and Circularity) | No | |
| 60 | Further work at EU, national and sub-national levels to determine the cross-substitutability of different wood categories between the various real end uses available in a given geographic area as one basis for determining priorities. | | No | No | | | |
| 61 | Market distortions which favour one group of wood buyers over another should be eliminated or at least curtailed or better directed. | | No | No | | | |
| | Member State Initiatives | | | | | | |
| 62 | Guide on Sustainable Procurement – Belgium | Vito (2013) | | | | | |
| 63 | Sectorial agreement aiming at increasing the supply of wood products sourced from forests | Vito (2013) | | | | | |

| | Policy name and description | Source | External constraints | Within scope of study? | Number and type of risks addressed | Existing MS or industry initiative? | Mitigation hierarchy |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------|------------------------|------------------------------------|-------------------------------------|----------------------|
| | <i>Criteria for exclusion II</i> Policy name and description | | Yes | No | None | No | Lowest |
| | that are sustainably managed – Belgium | | | | | | |
| 64 | Dutch Sustainable Trade Initiative, a public-private partnership for accelerating sustainable trade in e.g. tropical timber | Vito (2013) | | | | | |
| 65 | Forest Initiative for Global development / Focali (Forest, Climate, and Livelihood research network) – Sweden | Vito (2013) | | | | | |
| 66 | Generational Goal – Sweden. The objective is to achieve zero deforestation or zero impact on the environment outside Sweden. | Vito (2013) | | | | | |
| 67 | Network on reducing food waste (private sector, governments, knowledge institutions). The project focuses on reducing the amounts of food waste in the retail and wholesale sector – Sweden, Denmark, Norway, Finland | Vito (2013) | | | | | |
| 68 | Promotion of environmentally smarter food choices – guidelines on diet choices for health and the environment, called “Environmentally Effective Food Choices.” Sweden has become the first country to establish new food policies that consider the environmental aspects of human food choices along with individual health matters | Vito (2013) | | | | | |
| 69 | Time-bound voluntary private sector commitments, e.g. Voluntary commitment with food retailers and manufacturers on waste reduction targets – UK | Vito (2013) | | | | | |
| 70 | Consumer information: Guidance for industry on the application of date label to food (i.e. best-before and use-by) – UK | Vito (2013) | | | | | |
| 71 | Awareness raising (consumers and business) – UK | Vito (2013) | | | | | |
| 72 | Sustainable public sector procurement – UK. UK timber procurement policy, which requires that all timber and wood-derived products bought by central government departments (voluntary for local government, hospitals, schools etc) must be from: i) independently verifiable legal and sustainable sources; or ii) FLEGT-licensed timber or equivalent sources | Vito (2013) | | | | | |
| 73 | REDD+ finance – UK | Vito (2013) | | | | | |
| 74 | R&D – UK. Research into UK palm oil | Vito | | | | | |

| | Policy name and description | Source | External constraints | Within scope of study? | Number and type of risks addressed | Existing MS or industry initiative? | Mitigation hierarchy |
|--|--------------------------------------------------------------------------------------|--------|----------------------|------------------------|------------------------------------|-------------------------------------|----------------------|
| | <i>Criteria for exclusion II</i> <i>Policy name and description</i> | | Yes | No | None | No | Lowest |
| | consumption and a review of policy options relating to sustainable palm oil sourcing | (2013) | | | | | |

Appendix F Indicators

To assess whether any of the effects of increased EU demand for US forest biomass constitute a risk to the policy objectives outlined in previous sections, a number of indicators for environmental implications is identified and briefly described in the below. The link between policy objectives and indicators for environmental implication can be seen below.

Table 8-40.

| Indicator | Short description | Relevance to policy objectives | | | |
|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|----------------|---------------|--------------|
| | | Biodiversity | Climate Change | Deforestation | Material use |
| Loss of habitat | Temporary and permanent loss of forest habitats incl. effects on biodiversity. | √ | | | |
| Nutrient loss and leakage | Alteration of nitrogen and phosphorus levels in air, soil and water. | √ | | | |
| Freshwater quality decline | Pollution of rivers and freshwater bodies with organic matter and ammonium and other substances of anthropogenic origin | √ | | | |
| Loss of forest area | Change in area of natural and extensively managed forests | | | √ | |
| Declining levels of stock | Amount of biomass stored in natural forests and plantations. Stocking levels are depleted when the amount of wood removed is larger than that planted and added as incremental growth. | | | √ | |
| Hemeroby and fragmentation | Degree of human influence on the forest area and fragmentation of forest (i.e. the degree to which movement between different parts of the landscape is interrupted by barriers). | | | √ | |
| Loss of Carbon stock | Amount of carbon stored in woody biomass and soil carbon. Carbon stocks are depleted when the amount of carbon stored in wood removed is larger than that planted and added as incremental growth. | | √ | | |
| Soil Carbon loss from drainage of wetlands | Drainage of wetlands leads to carbon losses as organic matter that has accumulated in soil becomes exposed to air, and thus oxidized, leading to CO ₂ emissions. | | √ | | |
| GHG emissions (tCO ₂ e/capita) from production and use of wood products | The GHG emissions resulting from the production and use of woody biomass. Unfavourable use of resources when GHG emissions increase. | | √ | | √ |
| Material competition | The use of wood as raw material in various sectors (energy, construction, pulp and paper, etc.) depend on prize and supply/demand levels. Increased competition can lead to unfavourable resource allocation. | | | | √ |
| Decreasing cascade use and Circular Economy issues | Less cascade use (wood products having multiple uses before end-of-life use as energy source) of woody biomass, and less circular economic use of biomass (biomass entering multiple resource streams) | | | | √ |

Appendix G Summary of comments on Brussels Workshop received

Comments from:

- › Individuals: 2 researchers, 1 expert panel member
- › Industry: Westrock, DRAX, Weyerhaeuser, Enviva
- › Interest groups: Southern Forests, AEBIOM, Plum Creek, AF&PA, NCASI, US Industrial Pellet Association, Oak Ridge
- › Government: US Government
- › Other: VITO

16 comments in total, some more than 15 pages long. Generally, participants were happy with the Issue Paper.

Topics addressed in comments – Industry

- › Disagreements between Industry players (examples below)
- › Demand and prices
 - › Quantity of biomass imported into the EU from the US is very small; EU biomass demand represents just 2.8% of US timber production (Drax)
 - › Estimates of potential demand included in the report are high and are out of date (Weyerhaeuser)
 - › Correlation between pulpwood price increases and rapidly rising demand for export wood pellets. Export pellet demand created by the UK subsidies having direct market effects (WestRock)
 - › Biomass and pulpwood are the lowest value product from the forest. Sawtimber drives management decisions, not biomass or pulpwood (Weyerhaeuser)
 - › Surplus of fibre in the US South; growing stock has been increasing whilst annual harvesting and demand from the traditional forest industry has been declining (Drax)
 - › Study suggests only longer-term economic impacts on the traditional wood users, but pulpwood prices are already rising as a direct result of the new demand for pellets for export for EU bioenergy (WestRock)

- › Source of stocks
 - › As indicated in the findings, and contrary to what pellet mills indicate, the vast majority of feedstock comes from commercial roundwood (WestRock)
 - › The industrial wood pellet sector primarily uses feedstocks that could be used by the pulp and panel board sector. Pellet mills are locating in areas where traditional markets have declined or where there is a substantial surplus of fibre to avoid competition (Drax)
- › Environmental impact
 - › Critical that the report focuses on proven links between demand for wood pellets for export and consequent environmental impacts (i.e. not trying to ascribe historic practices of other industries to pellet industry (Drax)
 - › Positive impact of demand for bio-energy across the wider US forest system over time, likely leading to enhanced forest area and greater quantities of stored carbon (Enviva)
 - › Addressing environmental risks associated with enhanced wood pellet demand through SBP certification; SBP certification for Biomass Producers will become the default for market entry, this must be reflected (Enviva)
- › Other issues:
 - › Incorrect to assume that demand for industrial pellets in the EU will causes changes in forest management practice in the US South (Drax)
 - › Landowners respond to robust markets by growing more timber (Weyerhaeuser)
 - › Briefing paper does not adequately address problems associated with feedstock definitions; development of clear and unambiguous definitions of feedstock is needed to ensure parties understand and utilize common language (WestRock); "importance of precision in defining "roundwood" and other forest-derived feedstock types" (Enviva)
- › EU action
 - › Detailed reporting by the biomass user having regard to the whole of its supply chain, regular audit certification by independent auditors, and effective penalties for violations, must all be built into the enforcement scheme (WestRock)
 - › To the extent that subsidies are involved, penalties for violations must include immediate suspension of those subsidies (WestRock)

- › Findings indicate slight but statistically significant changes in forest conditions over a short time period (2006-2012), at low levels of demand. Important to look at changes in forest conditions beyond 2012; majority of the pellet mills and increases in pellet production have occurred since 2012, and will continue to increase in the future (WestRock)
- › As the study moves forward, it is essential that the perspective of the forest landowner be at the table (Weyerhaeuser)

Topics addressed in comments – Interest groups

- › Demand:
 - › Total imports, not only from the US, represents less than 3% of the total EU biomass consumption (AEBIOM)
 - › Biomass for energy plays a role in substituting decreasing demand from pulp and paper industry (US IPA)
 - › Market forces, not government subsidies, should determine the use of wood biomass for renewable energy → concerns that markets are being distorted, e.g. UK subsidies (AF&PA)
 - › Concern that Roundwood is used for pellet production, competition with pulp mills and other uses of biomass due to price inelastic demand (AF&PA)
 - › Demand for wood in the United States results in investments in forestry that help to prevent loss of forest and incentivize afforestation (NCASI, US IPA), management decisions dictated by the sawtimber markets
 - › Actual capacity and projected growth of wood pellet market smaller than stated in paper (US IPA)
- › Some groups not invited/able to participate (e.g. private land owners in the US)
- › Forestry regulation in the US (Southeast) is not insufficient; forestry is a well-regulated, and highly important economic sector within the US (Southeast) (AF&PA, US IPA)
- › Aggregate demand in wood for energy will not lead to deforestation (US IPA)

Topics addressed in comments – Other participants

- › Mitigating impacts

- › Post-consumer waste wood should be concerned as feedstock (individual)
- › Lowering cost of certification for small, privately owned forest parcels (individual)
- › US Government
 - › Insufficient citations of previous research to evaluate the scientific merit of some of the arguments advanced in the briefing paper; technical terms need to be more clearly defined
 - › Each of the potential effects of increased biomass demand could be more clearly stated as a question, or as a hypothesis, rather than a fact.
 - › The list of negative effects from increased harvest seems comprehensive. No mention is made of positive effects.
 - › Comments on interpretation of Federal Legal Acts (CWA, ESA) and State Laws
 - › Effect 1: No evidence is provided regarding potential effects on water quality, GHG emissions, or biodiversity
 - › Effect 4: The statement that growing demand places increasing pressure on high biodiversity areas is a “common perception” needs to be supported with citations
 - › The current description of the debate surrounding GHG accounting and the EPA’s biogenic CO₂ assessment framework does not accurately represent either the debate or the framework

Topics addressed in comments – final remarks

- › General satisfaction with workshop and Issue Paper
- › Links to relevant information sources and papers provided by most commenters
- › Significant interest in study results and outcome

| <i>Summary of comments</i> | <i>Response</i> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The empirical analysis of wood utilization and effects on forest attributes (ch. 6) unfortunately only addresses the short history of the industry. This is a useful exercise as an approach to monitor and measure impacts, but is limited with the currently available data. | The report addresses the data limitations and we agree this approach is useful for monitoring. |
| The current state of southern U.S. forest resources comes from a history that includes farm abandonment and a trend toward intensification of management (in the form of pine plantations) such that over three fourths of coastal plain pine harvest is from plantations. That, in concert with declining demand for hardwoods, has led to stability in timberland area and reduced harvest pressure on remaining natural stands. While it would be convenient to attribute this to long term foresight with a view toward sustainability, it emerges from a combination of ecological characteristics of the region, private ownership, and increasing demands. Ecologically, trees will grow in the south unless money is spent to suppress them. So a lack of alternative land uses can lead to more forest and growing carbon stocks. The south's agricultural land is marginal from a national perspective (meaning that Iowa corn cropland is much more productive). So a fragmented landscape of marginal ag land that reverts to forest when abandoned or that can be more profitable in trees when markets/policy dictate, leads to a diverse southern timber resource and economy that produces more timber than any other single country. | These relationships are duly noted and communicated in the report. |
| Assuming demand is small (20% of pulpwood for paper) oversimplifies the local effects. | The report addresses this very issue that while demand for pellets is small relative the rest of wood users across the southeast, localized effects can occur. |
| The discussion of potential effects is similar to those identified in Forests 2014 (5): 2163-2211 | We make reference to this citation as it concludes similar effects and trends as this report. |
| An analysis by scientists at the Oak Ridge National Laboratory in the US concluded very similar results, using similar methods, as was conducted and presented in chapter 6. | The report does not cite this reference as it was not finalized when this report was made final, but we do acknowledge the similar analysis and conclusions supports the validity of this work. |
| Workshop participants presented data on increasing timber volume in the US southeast. | These data were thoroughly discussed in the report. |
| Comments from industry (traditional products and pellets) focused on sources not cited in the workshop briefing paper | These sources have been cited in the final draft report, as well as the issues captured in these sources. |
| Unambiguous definitions for pellet feedstock are needed | clear definitions are included in the full |

| | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| | report. |
| A discussion of subsidies and their impact is necessary. Contested data were presented from the traditional industry and the pellet industry. | The nature of this debate is summarized in the full report and the data discussed. |
| Accurate market data on current export volume needs to be used. | The final report does include this. |
| Current levels of demand are quite small relative to other wood users | The final report acknowledges this fact. |
| The industrial wood pellet industry, while contributing to overall healthy forest markets, is not lucrative enough by itself to motivate a forest owner to convert lands to plantations. Conversion and management decisions are based upon the high-value sawtimber industry and will not be influenced by the small, low-paying pellet market | These dynamics and the potential role of increasing pulpwood demands are explored in great detail in the report and are actively debated. |
| The list of negative effects from increased harvest seems comprehensive. No mention is made of positive effects | Positive effects are discussed in the full report. |
| Information on the nature of state BMP programs was provided, i.e. the nature, regulatory, quasi-regulatory, non-regulatory. | This data was incorporated into the appendices. |
| As the effects of most concern seem to be focused on the hardwood resource, the U.S. Forest Service evaluated the evidence in two recent publications from the Southern Forest Futures Project addressing the coastal hardwood resource: In an assessment of the Lower Mississippi Alluvial Valley, Gardiner (2014) concluded that the greatest threats are 1) deforestation for urbanization, 2) coastal subsidence and saltwater intrusion in the coastal swamps, 3) loss of land accretion along the Mississippi River due to channelization and engineering, 4) misguided harvesting practices in natural stands ("select cutting" to retain forest structure that actually results in timber stand degradation through high-grading and prevents bottomland oak sustainability), and, 5) emerald ash borer. All of these were determined to present more formidable threats to biodiversity in the LMAV than a growing pellet industry | The issue of hardwood impacts is explored in the final report is the broader context presented in this comment |
| Pellet mills are locating in areas of declining pulpwood demand. | This is addressed in the report and a citation is included. |
| Growth exceeds removals at the regional level | This is presented in the report and countervailing arguments with regards to this facts relevance to environmental effects is explored. |
| Data was presented from forestry consulting businesses on wood product paying capacity and price trends. | These data are presented and explored in the final report. |
| Data and perspectives were presented regarding the greenhouse gas implications of wood bioenergy | The final report includes a fairly comprehensive overview of the topic. |

Appendix H Workshop report

The workshop began at 14.00 and ended at 18.30 (CET) and took place at Rue Philippe le Bon 3, 1000 Bruxelles.

H.1 Introduction

HoU Claudia Olazabal, DG Environment, B1 welcomed participants to the workshop and introduced the study:

Ms Olazabal explained how the use of biomass for energy is governed by the renewable energy directive and its target which has driven a longstanding discussion on sustainability of the use of biomass for energy and the need for sustainability criteria. This directive as well as the 2020 target of 20% has driven a lot of changes in the market and a big increase in the use of biomass as renewable energy in the EU.

The reasoning behind the study is to assess which impacts the EU climate and energy goals have in other places of the world, in particular SE US. Then EC (Environment, ed.) Commissioner Potočnik along with many other commissioners received complaints from NGOs that EU renewable policy was driving deforestation and causing environmental damage in the US, which was backed up by scientists and NGOs in the US. Industry had different arguments and data. It was difficult to determine who was right and who was wrong. The issue warranted a closer look by the EC at what was going on.

Hence, Ms Olazabal explained that the study will investigate to what extent or not are the EU causing environmental damage and unsustainable harvesting of biomass in the US. However, the study will also inform the development of a renewed and enhanced biomass policy, as a part of a transformation agenda regarding energy in the EU.

Ms Olazabal outlined a couple of important questions; what is going on in a policy context in the US in terms of sustainability of biomass for energy use? Are there things the EU should be inspired by, and are there things the EU should avoid? The study is further fact finding regarding the actual policy frame; legal and regulatory trends, and policy discussions in the US in relation to the use of biomass for energy at federal and state (most advanced) level.

As such, it is the understanding of DG Environment that the study should build on two pillars:

- 1 Policy and regulatory framework and policy discussions in the US that could contribute to the thinking in the EU.
- 2 Investigate claims on environmental implications in Southeast US as a result of increased EU Import of biomass for energy from this region. What is going on more concretely regarding exports of pellets from the SE US to the EU?

Ms Olazabal reminded participants that the workshop is not a stakeholder consultation. It is a validation workshop where participants' input are required on:

- › Is anything missing in the findings?
- › Are there important issues and angles that have been overlooked?
- › Provide guidance to the consultants on gaps in the analysis that needs to be filled?

At a later stage, a conventional stakeholder consultation will be conducted if and when EC presents a legislative initiative on a new biomass policy.

Zoltan Rakonczay, DG ENV, briefly welcomed remote participants, noting that approximately as many people participate remotely as in the room. The web streaming will be recorded and can be accessed at a later stage.

H.2 Presentation of the workshop agenda and brief introduction to the Study

A brief presentation of the workshop agenda and the framing of the study was given by Project Manager Asger Olesen from COWI. It was emphasized that the study looks at US SE and not the overall North America as stated in the overall tender title. For further details on this part, see presentation by Mr. Olesen, COWI.

H.3 Presentation of key preliminary findings of the Study

Presentation of key preliminary findings of the Study on the Environmental Implications of the Increased Reliance of the EU on Biomass for Energy Imported from North America: Environmental Effects and Risk Mitigation Methodologies by Brian Kittler & Francisco Aguilar, Pinchot Institute for Conservation.

Brian Kittler presented the regional context of SE US regarding the following topics;

- › forests in the ES US,
- › forested areas and plantations,
- › forest ownership and industry as well as
- › state of biodiversity.

For further information, please refer to the presentation slides.

Will Price presented the policy framework relevant to Southeast US Forests. Mr Price presented an overview of the forest policy framework in the US to set the context of forest management policies in the SE US. He explained about public

policies as well as the way, which the private sector programs interact with the public policies. This is important since there has been a lot of effort and investments by forest industries and state agencies and federal government in reaching out to land owners and developing additional and incentives programs to practices sustainable forestry. This is different from managing risks, which there are not much enforcement of in the programs.

The overview addressed the following topics;

- › the overall policy framework,
- › Endangered Species Act (ESA),
- › Clean Water Act (CWA),
- › Water Quality BMPs,
- › State Policies,
- › Voluntary Programs/Incentives and certification as well as
- › the differences between SFI and FSC.

For further information, please refer to the presentation slides.

Brian Kittler gave a short presentation on existing and projected growth in the wood pellet sector in the SE US addressing the growth, supply needs, demand projections and supply

For details, please refer to the presentation slides.

Mr Kittler took over from Mr Price and presented the listed perceived environmental effects, as they have been identified by the work done:

- 1 Potential Effects of Aggregate Increase in Wood Demand
- 2 Forest Type Conversion from Natural Forests to Plantations
- 3 Displacement of Existing Wood Users and Possible Negative Effects
- 4 Pressure on Biodiversity
Significant overlap between important bird areas and forests being converted.
Very few of these are sufficiently protected (IPA)
- 5 GHG emissions
Distinction between the science of biogenic accounting and the policy aspects.
Focus on EPA biogenic emissions accounting process.

For details, please refer to the presentation slides.

Then, Mr Kittler invited Mr Francisco Aguilar to the stand to present the effects of greater EU wood pellet demand on forests of the Southeast US.

Mr Aguilar gave a presentation on effects of greater EU wood pellet demand on forests of the SE US. He explained that in order to get into the actual effects of the renewable energy directive the study looks at the actual data based on surveys on forest conditions. Further, the study looks at projects of what will be the net effect of EU policy on forest conditions. Francisco Aguilar present both the ex-post analysis and the ex-ante analysis.

For details, please refer to the presentation slides.

Discussion

After a short break the panel of invited experts, with a 5-minute first reaction each, kicked off the discussion. The panellists was tasked with giving short review notes based on the Issue Paper and the presentations. The five panellist are were:

- › Ms Sini Eräjää, EEB/ Birdlife Europe
- › Professor Bob Abt, NC State University, US
- › Mr Ben Larson, National Wildlife Federation, US
- › Mr Thomas Buchholz, Spatial Informatics Group, US
- › Mr Robert Matthews, Forest Research, UK

After the panellists' notes, the floor was invited to give comments.

Pernille Sørensen, COWI, mediated the session.

Remarks by panellists:

Sini Eräjää, EEB/ Birdlife Europe:

Issues identified were key issues and correct issues. Much more information and detail out there, which was not presented in the paper. It would be helpful to get more detail on where roundwood comes from and what specifically it is used for. Assessment of raw material supply: 75% of material is roundwood. What kind of roundwood, where does it come from. NGO and industry should have information about where the roundwood come from? If we don't know where it comes from, then that is an issue in and of itself.

On regulatory framework Ms Erejaa stressed: Missing specific analysis of how analysis of RF matches with the issues identified. How can a 40% increase in demand not be a driver?

On the carbon side: Carbon impacts are linked to the source of the wood supply. There are numerous case studies on the carbon impacts.

Bob Abt, Professor:

Co-author of ex-ante study used by Professor Aguilar. Role is to provide a future outlook on a historical context.

The report should be very careful about putting demand fluctuations in context of the outlook and historical context. Clarifications of feedstock types for pellets and spatial scale (i.e. hardwood use here vs. there) and in relation to localized versus regional impacts. Issues of scale are complementary to understand the complexity of the issue. Policy + certification linkages = a quandary. New demand could represent new incentives to certify, but why for a low value product?

Ben Larson, National Wildlife Federation:

Strengthening the assessment that should be in the final report. The report must interpret the facts at issue within the historical context of the region.

- 1 First point: What we are talking about here is a region of the world that has global biodiversity significance. We need to understand this biological context – biodiversity protection is especially important concerning endemism. The region has global biodiversity significance and long-standing pressures. “EO Wilson has said that coastal wetlands have among the highest biodiversity value of ecosystems on earth”. High endemism (1700 plant endemics). Pine Savannahs, bottomland wetlands.

- 2 Second point: Protection of this biodiversity. No requirement in SE US for anyone to look and see whether there are threatened or endangered species – actually there is a disincentive. Effectively, there is no protection of these species, which is a key point the EC need to know. Opportunities for “low risk biomass” and “restoration biomass” need to be identified with volumes quantified.

- 3 Third point: Ecology. Two ecosystems: Savannah forests and hardwood forests. If you change from savannah forest to plantation, you close of underbrush.
 Go beyond the two areas. Usually, the understanding is that the saw timber markets drive the demand, as this is much more valuable. However, there is evidence that bottomland hardwood harvesting is driven by biomass demand. Forested wetlands harvests have been widely publicized (Wall Street Journal, Washington Post, etc.) and NGOs (e.g. Dogwood Alliance, 2013) have documented the link between these harvests and pellet mills. NGO concerns over effects on hardwood bottomlands of additional demand from Enviva. Documentary evidence of Enviva harvesting within high conservation value areas. There is a relation to lack of sawtimber markets (and thus residuals) in some of these areas.

- 4 Certification: Urge EC to develop incentives for FSC certification. Low levels of certification does not explain why some plants get there material from FSC certified forest. EC should encourage a certain percentage of biomass to come from FSC certified forest – starting low and then growing to a larger percentage over time. The differences between certification systems are real and significant (i.e. restrictions on conversion). Although adoption of FSC

certification is relatively low in the area options including group certification and premiums present opportunity to expand participation. Example of FSC premium à NWF managed group certificate in Alabama getting a premium for pulpwood from a pulp mill (mentioned a price premium of 20% per tonne)

- 5 Carbon sequestration: Time of sequestering of carbon. Burning trees does not reduce carbon, it is the regrowth of trees that sequesters carbon. The timing of emissions and the mitigation of those emissions (carbon debt, repayment) is the essence of the debate and not a part of sustainability. Need to complement GHG with biodiversity assessments as the former might overlook importance of biodiversity.

Definitions: Largely, definitions are driven by economics, need to add ecological-based definitions

Thomas Buchholz, SIG:

The issue paper and presentations are “very impressive,” and balanced. Carbon is of primary importance and should be elevated in the report in a way that makes this front and centre. Carbon assessments should take in the context of EU2020 renewable energy targets.

Very little scientific consensus on many of these points, let alone policy consensus. To me, the carbon piece is the most important part of this, as the RED has been drawn up as a mitigation policy. Carbon is the first point that should be made and discussed. This should be reflected in the report.

Baselines and counterfactuals – it should be made clear what impacts economics make. Defining appropriate baseline is one of the biggest things and the report should carefully communicate how while there is not consensus around C accounting there is widespread agreement that use of different baselines and counterfactuals can produce very different results.

Leakage is another issue, which is just as controversial. Present where the science stands right now. How can we move forward with contradictory and unsettled science?

Metrics – how do you want to make a statement in the end about carbon and impacts on climate change? It is an important report metric to determine whether pellet is C beneficial or not - over a time scale. Even if pellet use can reduce C emissions in the short term, it can increase C emissions over time. EPA C accounting framework: this report should capture as much as we can. Potential implications, policy advice for EU.

Robert Matthews, British Forestry Commission:

The title of the issue paper is inaccurate given the contents of the report. Strong appreciation of the work that the consultants have done. Very useful pen picture. A systematic approach to the depiction of risks and risk management (i.e. a risk register/ risk matrix) would be very useful to present. The use of FIA data

categories (carbon above and below in live & dead) is an interesting approach to carbon accounting. The selection of counterfactuals is very important.

Five observations:

- 1 Project involves assessment of risk and mitigation. The likelihood and impact of each risk. Might consider a matrix for prospects of adopting a “Risk Register” – include likelihood of risks, extent of risks, probably impacts presented in a sensible way.
- 2 What to do, not only what not to do. Mitigation will involve taking positive action, not just avoiding negative action. It should describe positive actions, not limit to description of risks.
- 3 Weakness of the project is that it is solely on risks. A balanced project will also look for positive outcomes. The report should aim for recommendations for positive outcomes e.g. using low-risk biomass resources.
- 4 Quantifying impacts is about quantifying impacts on climate change. Considerable debate, sensitive to assumptions made. If you are going to identify appropriate mitigation action. What are the big negative actions and where are they taking place. We need to reach appropriate calculation methodologies. Any LCA practitioner will tell you that the method depend on questions asked; be specific on the question asked. Need to quantify impacts on GHG assessment, still many unsettled issues (e.g. methods, correct assumptions to answer pertinent questions), but should nonetheless identify ‘big’ negative impacts.
- 5 Forests in this region. Are we confident that this level of production will continue in the future? Uncertainty in future risks, e.g. forest resilience capacity could decline with climate change

The issue of definitions is important and he wishes good luck to the project team with clarifying this. Feedstock definitions should be related back to environmental effects. Ultimately consumers need help identifying low risk biomass sources. EU may not be in a position to regulate other regions (e.g. SE US) but can regulate EU pellet consumers to mitigate impacts

Comment section:

Kenneth Richter, NRDC:

This is an “important discussion” and the issue paper is sound.

The finding that 75% is pulpwood is consistent with our understanding of the situation too, but the 75% figure contradicts what we [NRDC] have been hearing from industry.

The existing assumption that burning wood is inherently carbon neutral (*a priori* carbon neutrality) can no longer be maintained.

Data was only from 2012 – as the RED was only implemented in 2009 and as there is inertia in the system (converting plants to pellets, etc.), [I/Richter] would question whether the full impact can be seen already in 2012, and there is need for newer data.

As the goal of the RED is to reduce GHG emissions, it is surprising that there is not more focus on this aspect in the report. Mr Richter asked whether this will be included in the other [final] report.

Allison Gratz, Enviva:

Mrs Gratz noted that she was specifically looking at gaps. There are ways you can get a more complete picture, and there is a need to fill in data gaps where possible to strengthen study.

- 1 Lots of plantations, especially on NIPF lands, are reliant on pulpwood market and pellet demand for thinnings. Gaps in current pulpwood demand does exist spatially (i.e. where pulp mills have vacated). There is significant understory vegetation in pine plantations that plays important biodiversity role. Distinction between plantation and not having an understory.
- 2 Increased demand for pellets; what's missing is that the pellet demand is taking over the decline in demand from the pulp and paper industry. There is a difference between what the paper industry was historically purchasing and what is being procured as biomass. Need to identify where pellet demand is just replacement demand vs. new demand. Pellet demand increase does not imply equally larger demand on the forest resource.
- 3 Certification: SBP will become the norm, look into SBP. Look deeper into what the two systems do.
- 4 Clear definition of what is residual and what is roundwood is needed. Feedstock definitions need to be clarified in the report and point of contentions need to be elucidated. "Some roundwood is a residual" with the example of tree-tops given.
- 5 Difference between perceived risk and real risk, and what do we do if it actually is a risk. Need to clarify whether risks are perceived risks, real risks, opportunities, and what can be done about risks. How are risks to be ranked?

FA:

Ex post and Ex ante analysis to balance the lack of information.

Tangui van der Elst, Westrock:

Noted that Westrock had additional sources, which they will share.

The traditional pulpwood industry is "doing very well." Need to drill down on the question of displacement. Today, there is market distortion that is creating price increases because of the subsidies for pellet. Market distortions (e.g. subsidized pellets) are creating price increases in some locations, in others there could be an opportunity for growth in demand. The 75% pulpwood figure for pellets is correct.

Definitions need clarification: what is a product, what is a residue? Need for clearer definition of what constitutes biomass feedstock.

Limitations based on data availability.

Very inelastic demand curve and very inelastic supply curve.

AF&PA – Paul Noe

Need clear and better definitions for feedstock. Overwhelming majority is roundwood and wood product residuals. Pulpwood using industries increase 6.8% from 2014 – 2019 [no source of this was given]. Risk of market distortion is high because of inelasticity of supply and demand (i.e. relatively low increase in demand can have significant price effects). RO, ability to pay for pulpwood stumpage is 240% of what the current market is. [No source of this was given. And clarification needed on this statement]

Pete Madden, CEO Drax Biomass:

Poyry, cites permanent capacity closure in the SE pulp & paper sector equal to ~2.2 million tons of pulpwood demand. Some concerns.

The Forisk number that is being raised on future pellet mills, one has to keep in mind that this depends on capital and other assets being available. Some of the mills that were included in the screening ended up not being constructed. Pellet mills placed in areas (wood baskets) where pulp and paper mills have been closed. This needs to be factored into the characterization of future demand scenarios. Demand projections need to be clarified. The Forisk projections already have a few instances where plants that past the Forisk screening are not going to be built. It is challenging to secure capital investment. Investment needed to convert natural forest to plantations does not make sense in regards to pellets.

Sees challenges of involving millions of landowners in certification programs. Most have less than 50 acres of ownership. Claims of economic displacement. Subsidies need to be linked to sustainability frameworks.

Carbon issue needs to be solved before other sustainability issues are addressed. “long-time frames of forestry vs. short time-frames of policy.”

Sini Eräjää:

Definitions of what constitutes feedstock need to be clarified.

Should look into overlap of biomass pellet plants and pulp and paper plants in the region.

Ben Larson:

The fact that there are many small landowners make certification difficult. However, premiums and making it easier to obtain these certifications would provide a great incentive for these landowners.

Natalie Hemeleers, European Biomass Association:

Provide a European perspective. Put things into context. More than 95% of the biomass consumed in the EU is produced in the EU. This needs to be clarified in the study up front.

The study needs to clarify that for many risks there is no clear answer to the risks question.

The report should be comprehensive on the topic of C accounting in terms of the literature it cites.

Bioenergy could be considered a carbon investment

Niclas Scott, University of Copenhagen:

Clear impacts of impacts – make it clear that there are no clear answers to this question.

Carbon debt: There is substantiate amount of carbon debt literature, which you should look into. How much information can you get out of these studies – difficult to go from carbon debt to policy making.

Ulrich Leberle (Raw Materials Director CEPI):

Question of certification. The study is about giving guidance – not the role of the EC to give guidance to a region outside of EU about the certification
Subsidies should be better targeted and linked to sustainability criteria.

Shall the EU recommend rules for other regions? Can EU policy solve issues of ecological integrity in other nations? The issue of C should be settled first.

Ben Wigley (Vice president Forestry Programs, NCASI):

Aspects related to sustainability; found the discussion of that topic to be incomplete, esp. with regards to BMPs. Land owners and loggers are buying into BMPs, and it doesn't matter whether its non-regulatory, regulatory or quasi-regulatory.

Report lacked a discussion of state water-quality laws. It is the law in many states that they cannot impair water quality.

Discussion of ESA and CWA incomplete.

Discussion of natural versus planted stands need to be elaborated.

Opportunities to improve the report:

- › NASF report. Best Management Practices are effective policy tools (90% effectiveness) to reduce impacts of forest operations (particularly water quality) and there is no difference in effects whether these are mandatory or (quasi) voluntary.
- › Discussion of state water quality laws requiring “not to impair water quality.”
- › The certification bodies should be allowed to review the sections of the report about their systems. For instance, stringency of SFI fiber sourcing standard.
- › Discussion of natural vs. planted. Biodiversity in planted forests depends on how they are managed. 75 – 80% have an open canopy vs. closed. For instance, longleaf pine managed to restore historic forest conditions. Active management has resulted in increased longleaf pine forest area in the last 15 years.
- › Parallels in ‘low-risk biomass’ and qualified biomass outlined in EPA’s Clean Power Plant.

Thomas Buccholz:

Article: Low-risk biomass.

Bob Abt:

Very little residue due to downturn in housing industry.

Robert Matthews:

Need better guidance of low risk source of biomass. Point was made about what is the scope of the EC to regulate what is going on. If the point is taken that the EC should not regulate outside EU, but should regulate large users within the EU, then what mitigation options exist.

Ben Larson:

Clearly the EU should not regulate forests in the US, but the EU should regulate the use of biomass in the EU. Lots of standards and specifications exist within the wood industry (e.g. pulp, timber) – what are the standards that exist for the biomass? Entirely legitimate to set the standards for this new kind of wood product.

Sini Eräjää:

It is about the impact we have created with the demand increase our policy has created. First question is, does it even make sense to go across the Atlantic to get wood supply, secondly, does it make sense to burn wood for energy?

H.4 EU action

Presentation

Presentation on next step: Identifying EU action to mitigate potential risks to EU policy objectives, by Project Manager and Policy Expert Asger Olesen COWI.

The purpose of Mr Olesen's presentation was to frame the discussion on EU policy action: The purpose of task 4 is to characterize risks with respect to EU policy objectives, as a result of increased EU demand for biomass for energy from the SE US. Mr Olesen explained how for the purpose of this study, objectives are not to be necessarily the same as targets, but rather the behind lying political motives for particular EU action. Thus, risks to the achievement of EU 2020 targets or GHG reduction commitments under the Kyoto Protocol will not be assessed under this study.

The objectives can often be found in introducing chapters of Communications or Impact Assessments, and in recitals of legislation. Major objectives are for example the general purpose of international commitments, treaties or conventions, which the EU as community has signed up to. Most notably we will focus on risks related to the objectives supporting the UNFCCC (including deforestation as part of REDD) and UNCBD/CITES, but also objectives related to major relevant EU legislative packages such as the Biodiversity-, Bio-economy-, Low Carbon-, and Forest Strategies, the 7th Environment Action Programme, Resource Efficiency

Roadmap and possibly the Circular Economy Package. Also, air and water pollution should not result from EU demand for biomass. These latter concerns indirect effects, and the EU would for reputational reasons not want to see the negative effects on air and water environment. The list of preliminary potential policy objectives can be found in the slide material.

Mr Olesen then explained the overall methodology to link environmental effects or implications to EU policy objectives. The preliminary risk categories was presented (see list as part of Issue Paper and under Brian Kittlers presentation). He stressed the importance of distinguishing between environmental implications in the US and risks to EU policy objectives. In the study effects in the US is not termed risks.

Mr Olesen made clear that risks would not be linked to a particular supply chains or MS and not evaluated quantitatively. The study will not link risks to RED and RE targets, and risks will be evaluated for probability and magnitude, but this will mainly be a qualitative exercise.

Mr Olesen presented a slide that framed possible EU action to address risks (slide), and stressed two important points:

- 1 There are certain constraints to the policy options that can be devised: WTO rules and internal market rules must be complied with,
- 2 Only action that concerns EU demand side can be taken. EU cannot and will not oblige US forest owners or other actors to certain management, actions or practices.

The study needs to respect these constraints. Lastly, he outlined a few examples of possible tools, however not, not ranking and concluding. All in all, actions that could be taken from Brussels to influence EU demand are inside the scope.

Discussion of EU action points

Discussion on potential risks and EU mitigation actions, facilitated by project manager Asger Olesen, COWI. The Session will produce input from the audience on risks and possible EU action.

Summary points:

- › Qualitative or quantitatively, but try to identify risks and their extent.
- › Need to incentivize the use of certain types of biomass? Promote practices that promote ecological objectives.
- › Consider framing counterfactual scenario into regulation, but consider something 'implementable'. Consider historic developments such as OSB industry 'displacing' other wood product industry sectors.
- › Should not ignore environmental effects, e.g. air quality impacts in the US.

- › Ensure compatibility of any EU regulations with other nations’.

Sini Eräjää, Birdlife:

Clarification: On what basis did you do the effect-risk entries in the overview table?

→ ASOS: They are purely indicative and should not be scrutinized. Table serves to spark a discussion on the methodology. The supporting work has not been done yet, as it will largely be informed by this workshop.

Peter Coleman, DECC:

Will you review the US INDC?

→ ASOS: As such, the study will not look at INDCs. Not all and not consistently. Only if and when relevant. The US INDC has not been included so far.

Was it in scope to look at the responses of MS to mitigate some of the impacts of biomass dependency?

→ ASOS: Only EU action is in scope. No recommendations on possible US action and specific MS action will be given.

Luc Pelkmans, VITO:

Countries are taking action due to lack of EU action. EU action should build on existing MS action.

→ ASOS: Please recall that the former initiative negotiated until 2013 in EC was proposed based on the articles of the TFEU that concerns the internal market – not the cross border environment issues articles. A key challenge is that too many MS approaches may risk distorting an internal market. We are not requested to develop MS level options, but EU action. EU action can include aggregating existing MS approaches but we have not developed these options yet.

Niclas Scott Bentsen:

You have to be very careful how you frame these risks and opportunities.

→ ASOS: You are absolutely right. Inputs are most welcome.

John Arsenault:

Will strongly suggest that you look at the existing structure that has been put in place by some of the MS. SBP tries to address some of these.

→ ASOS: the reason for the EU to consider legislation was that national regulation might lead to market disturbance.

Brian Kittler:

Question for Robert Matthews: Does this table meet the requirement for the risk assessment that you asked for.

→ RM: We must not be caught up in details, but this is the kind of table I was looking for.

Robert Matthews: How will you deal with GHG accounting and negative GHG effects?

→ ASOS: It will be a delicate balance.

Kenneth Richter, NRDC:

We can agree that this is complicated, but we cannot use this as an excuse for inaction. We all agree that there are differences in types of biomass and their carbon emissions. We can no longer go on claiming that biomass is inherently carbon neutral, we need to account for the actual emissions. Any policy response need to have that element.

→ ASOS: it is not for this study to assess whether or not biomass is carbon neutral.

ASOS Questions (see slide)

- policy objectives?
- safeguards in place?
- can we reduce this impact?
- can we contain the impact?

Sini Eräjää, Birdlife

There is a need to think outside the box. What we have seen so far remains insufficient.

Niclas Scott Bentsen, University of Copenhagen:

You should also look into trade-offs between the different risk and effect categories.

→ ASOS: There are obvious upsides of this, which will be mentioned, were relevant. However, the scope of the study is "environmental implications", and thus as such more attention is lend to assessing negative effect rather than positive effects.

Ben Larson:

Consider including requiring or incentivizing beneficial biomass as a way to help mitigate and manage the indirect impacts of biomass harvesting. Much of the env impact will not be from where the biomass is harvested, but elsewhere. Impacts on Wildlife ILUC.

Peter Jordan:

A regulatory option would be to regulate against counterfactuals.

→ ASOS: It may be tricky to regulate counterfactuals

→ Zoltan Rackonczay: We do have cases were we regulate against counterfactuals.

→ ASOS: Thank you for all your valuable input. You can still provide written inputs. We will circulate a mailing address where you can provide these. We will share the presentations later.

H.5 Conclusion and wrap up

Conclusion and wrap up, by DG Environment (approx. 10 minutes).

Claudia Olazabal noted to participants that they could send comments to Asger Olesen and the other consultants within two weeks. This will give us more time to include the necessary literature. Mrs Olazabal noted that this is one out of many studies (DG CLIMA, etc.); many other DGs are looking at these issues. Sufficient consultation processes along the way.

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